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United States Patent [19]

Allen

[11] **Patent Number: 5,899,303**

[45] **Date of Patent: May 4, 1999**

[54] **HOISTWAY DOOR SEAL STRUCTURE**

[76] Inventor: **Thomas H. Allen**, 2004 North 10th St., Boise, Id. 83702

[21] Appl. No.: **08/975,415**

[22] Filed: **Oct. 22, 1997**

Related U.S. Application Data

[63] Continuation of application No. 08/423,958, Apr. 18, 1995, abandoned.

[51] **Int. Cl.**[6] **B66B 13/08**

[52] **U.S. Cl.** **187/333**; 49/208; 49/209; 160/118

[58] **Field of Search** 187/333, 325, 187/334, 336; 52/243.1; 49/208, 209, 404; 160/201, 214, 118

[56] **References Cited**

U.S. PATENT DOCUMENTS

1,406,951	2/1922	Fehr .	
2,517,713	8/1950	Rissler	187/31
3,065,826	11/1962	Tucker, Jr.	187/52
3,074,124	1/1963	Bergstedt	20/19
3,425,162	2/1969	Halpern	49/425
3,734,238	5/1973	Secresty et al.	187/1
3,805,450	4/1974	Forcina	49/231
3,807,480	4/1974	Smart	160/1
3,817,161	6/1974	Koplon	98/39
3,912,049	10/1975	Holland et al.	187/61
4,058,191	11/1977	Balbo	187/1 R
4,115,953	9/1978	Brosenius	49/125
4,404,770	9/1983	Markus	49/235
4,592,270	6/1986	Vener	98/39
4,637,176	1/1987	Acock, Jr.	52/30
4,651,469	3/1987	Ngian et al.	49/223
4,735,293	4/1988	Everhart et al.	187/56
4,987,638	1/1991	Ribaudo	16/89
5,083,639	1/1992	Kappeler	187/51
5,165,142	11/1992	Pilsbury	16/90
5,195,594	3/1993	Allen et al.	169/48
5,305,855	4/1994	Rivera et al.	187/56
5,383,510	1/1995	Allen	160/310
5,427,205	6/1995	Saillio et al.	187/334

FOREIGN PATENT DOCUMENTS

0 478 938 A1	8/1991	European Pat. Off.	B66B 13/30
2315-598	6/1975	France	E05D 15/06
2582-343	5/1985	France	E05D 15/06
5-118180	5/1993	Japan	E05F 1/02
6-72681	3/1994	Japan	B66B 13/30
6032572	8/1994	Japan	B66B 13/30
2 219 618	12/1989	United Kingdom	E06B 3/46

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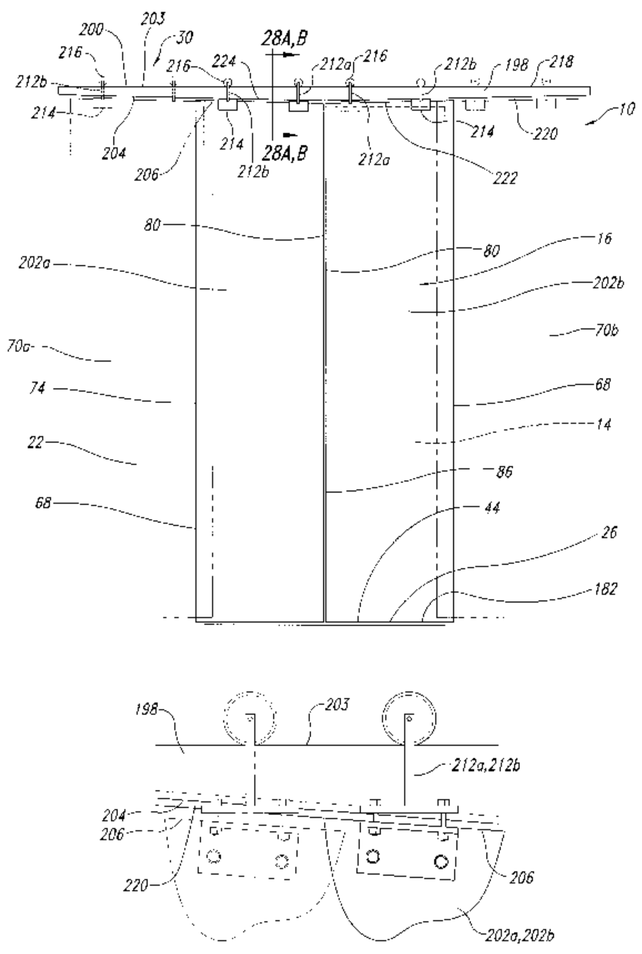
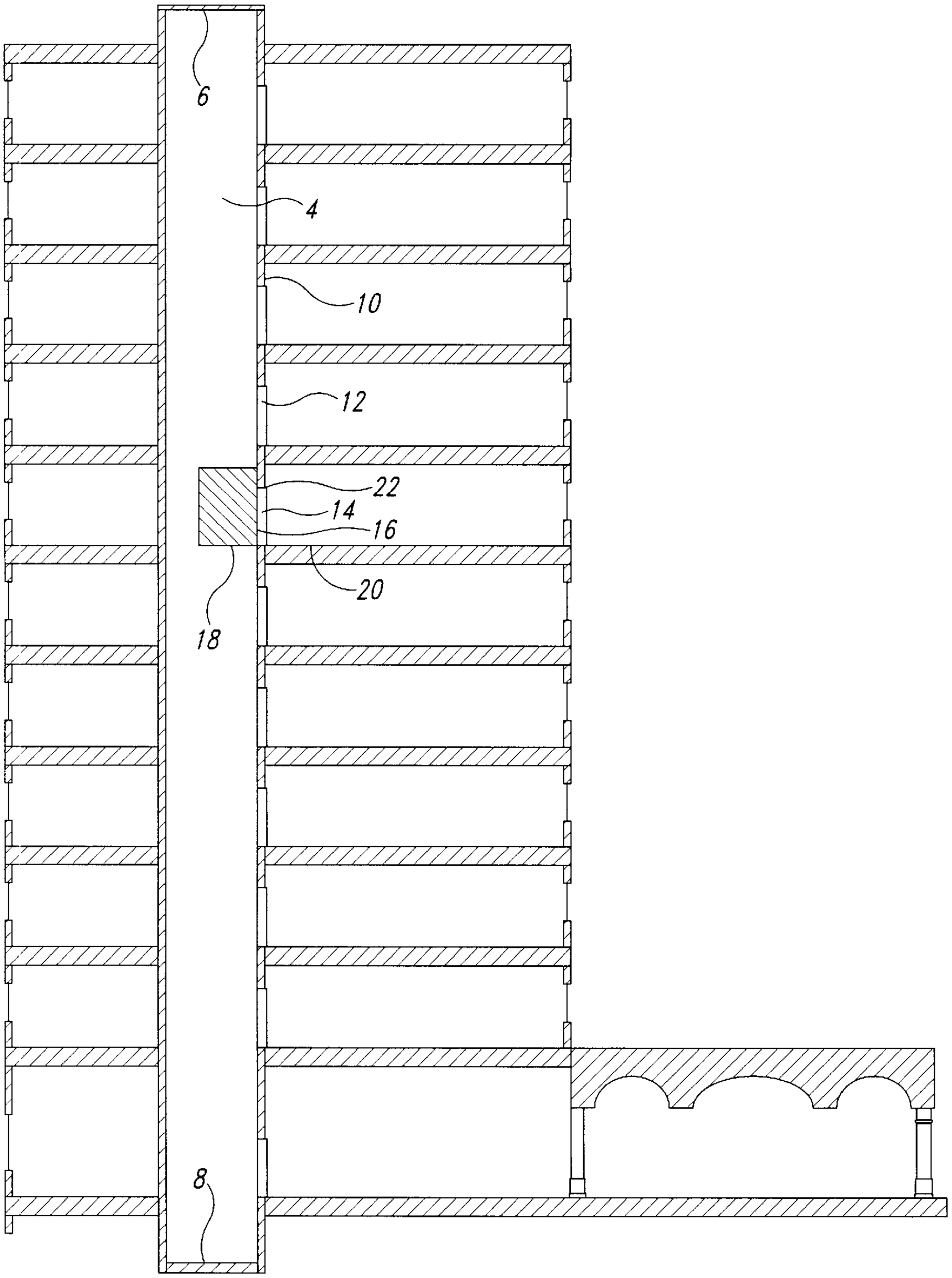
Assistant Examiner—Khoi H. Tran
Attorney, Agent, or Firm—Seed and Berry LLP

[57] **ABSTRACT**

A hoistway door seal structure for limiting the flow of air through a hoistway opening when the door is closed. The hoistway door seal structure includes a hoistway door that covers a hoistway entrance defined by an opening in a hoistway wall structure. An elongated door support member is connected to the wall structure and is positioned in a generally horizontal orientation above the hoistway entrance. A seal structure is supported between the hoistway door and the wall structure. A door support is connected to the hoistway door and is movably connected to the elongated support member to support the door while permitting movement of the door in a lateral direction between an open position permitting access to the hoistway and a closed position wherein the door substantially covers the hoistway entrance with a space between the hoistway door and the wall structure. The elongated support member includes a guide portion that guides the hoistway door, as the hoistway door is moved to the closed position, in a second direction toward the seal structure. The second direction being different than the lateral direction such that the hoistway door sealably engages the seal structure to seal the space between the door and the wall structure when the door is closed.

19 Claims, 32 Drawing Sheets





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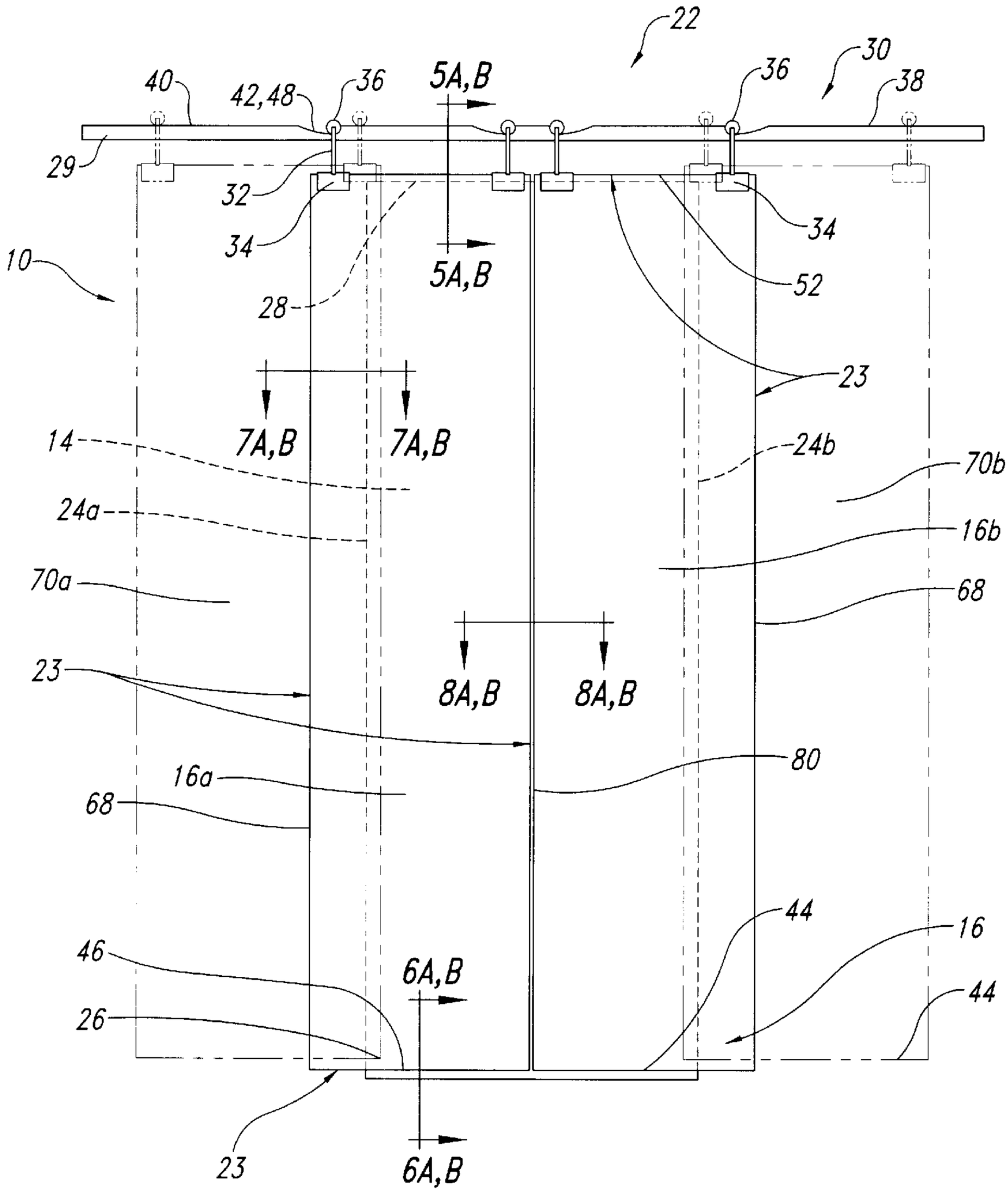
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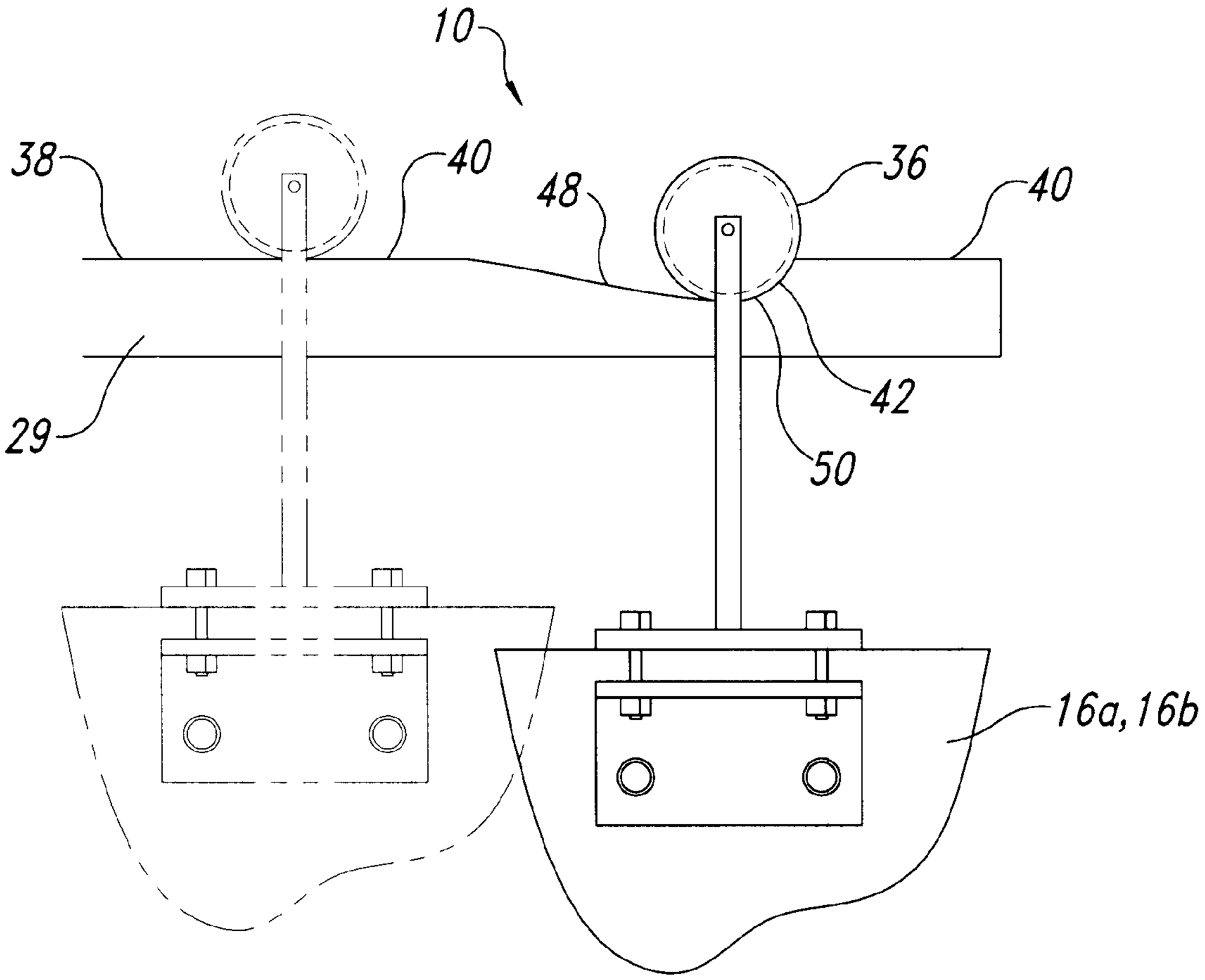
Fig. 2



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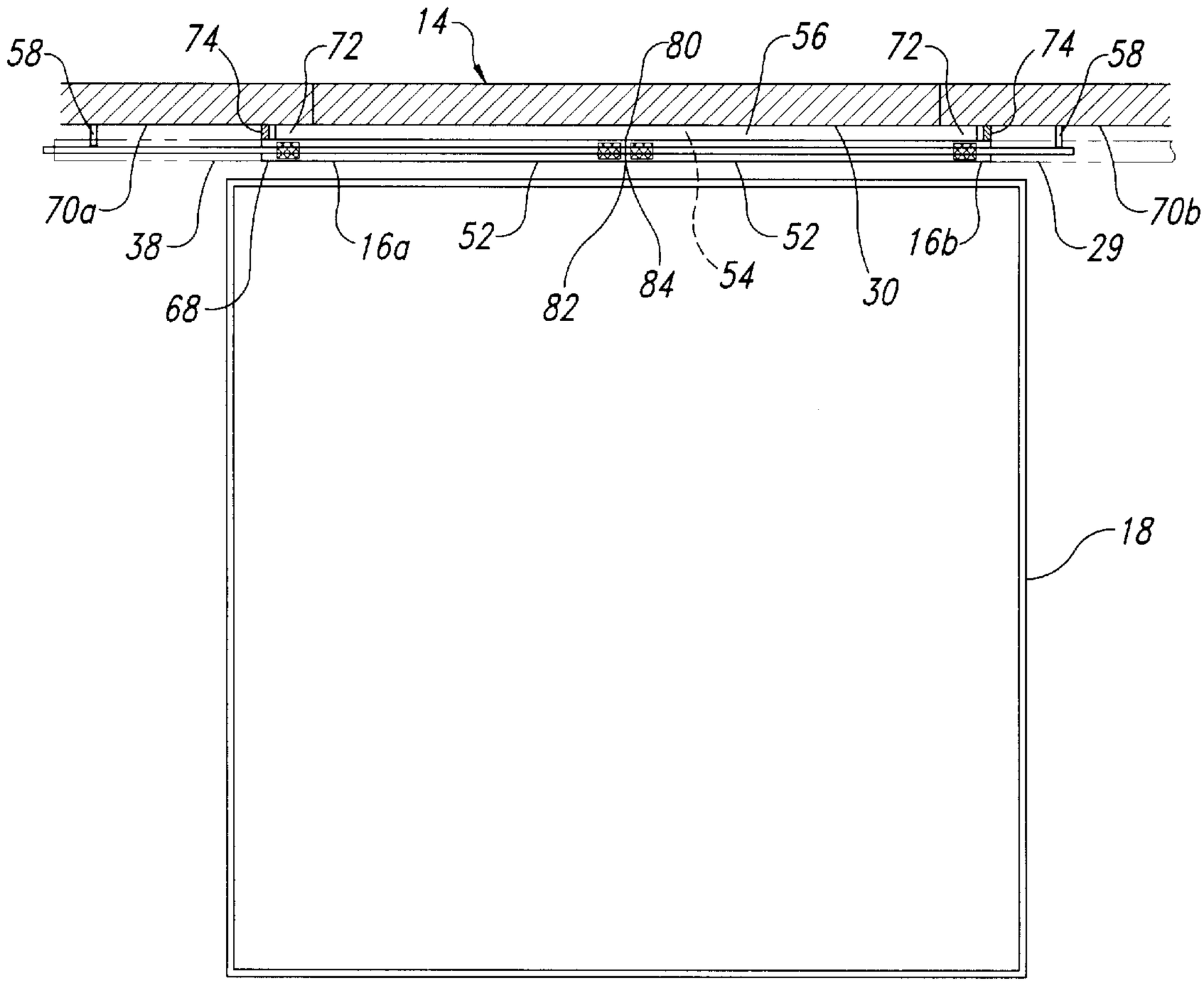
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Fig. 4

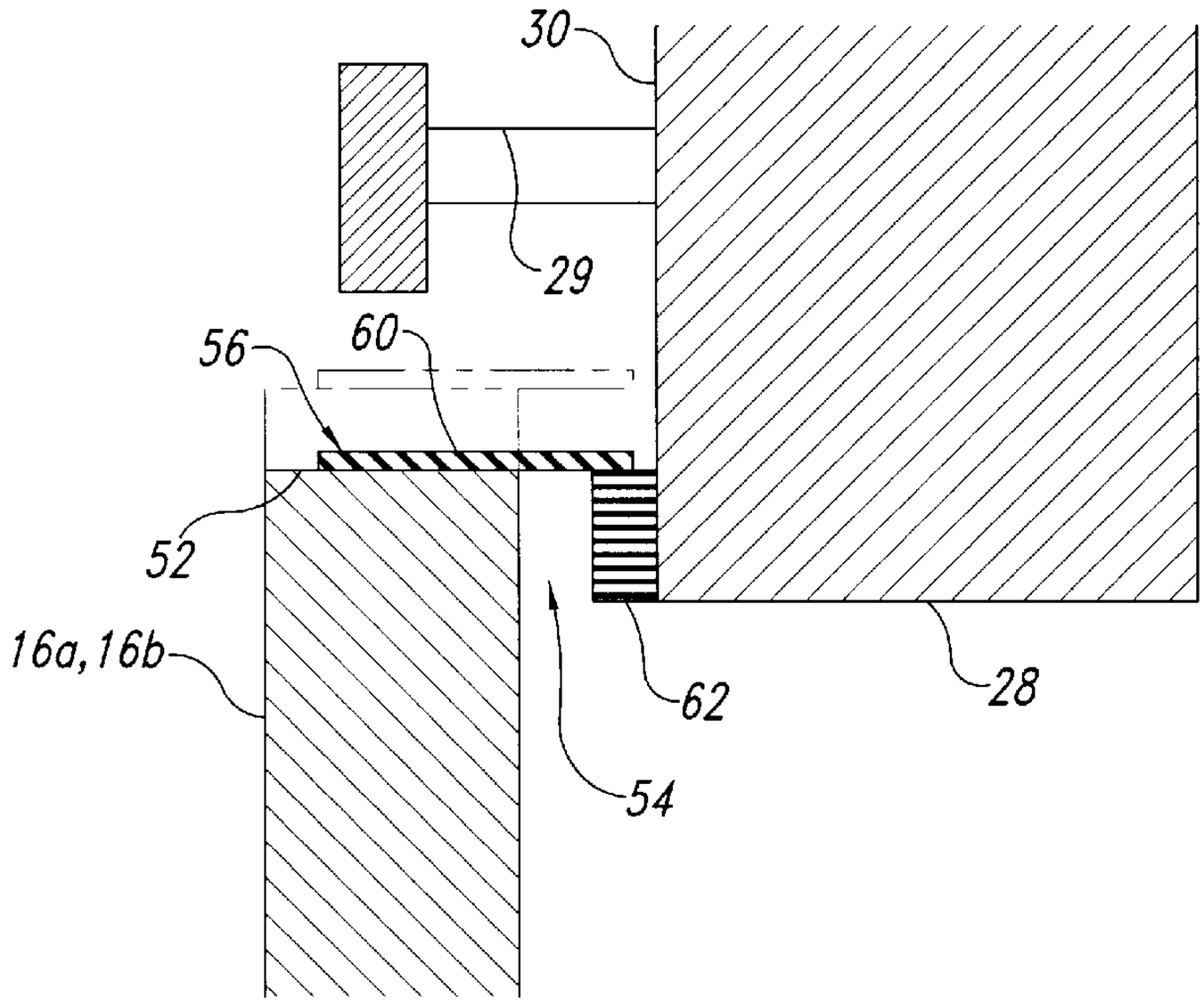


Fig. 5A

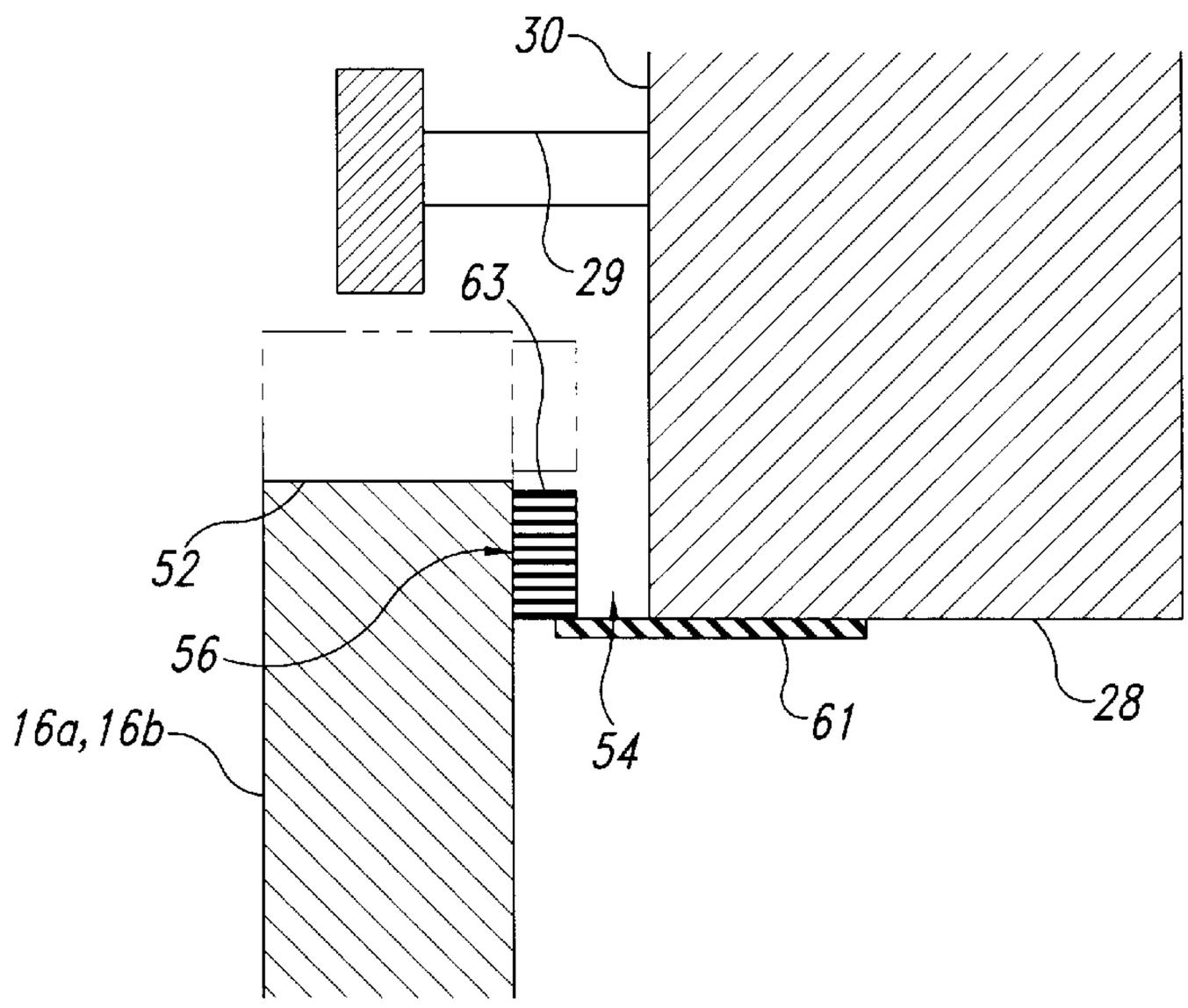
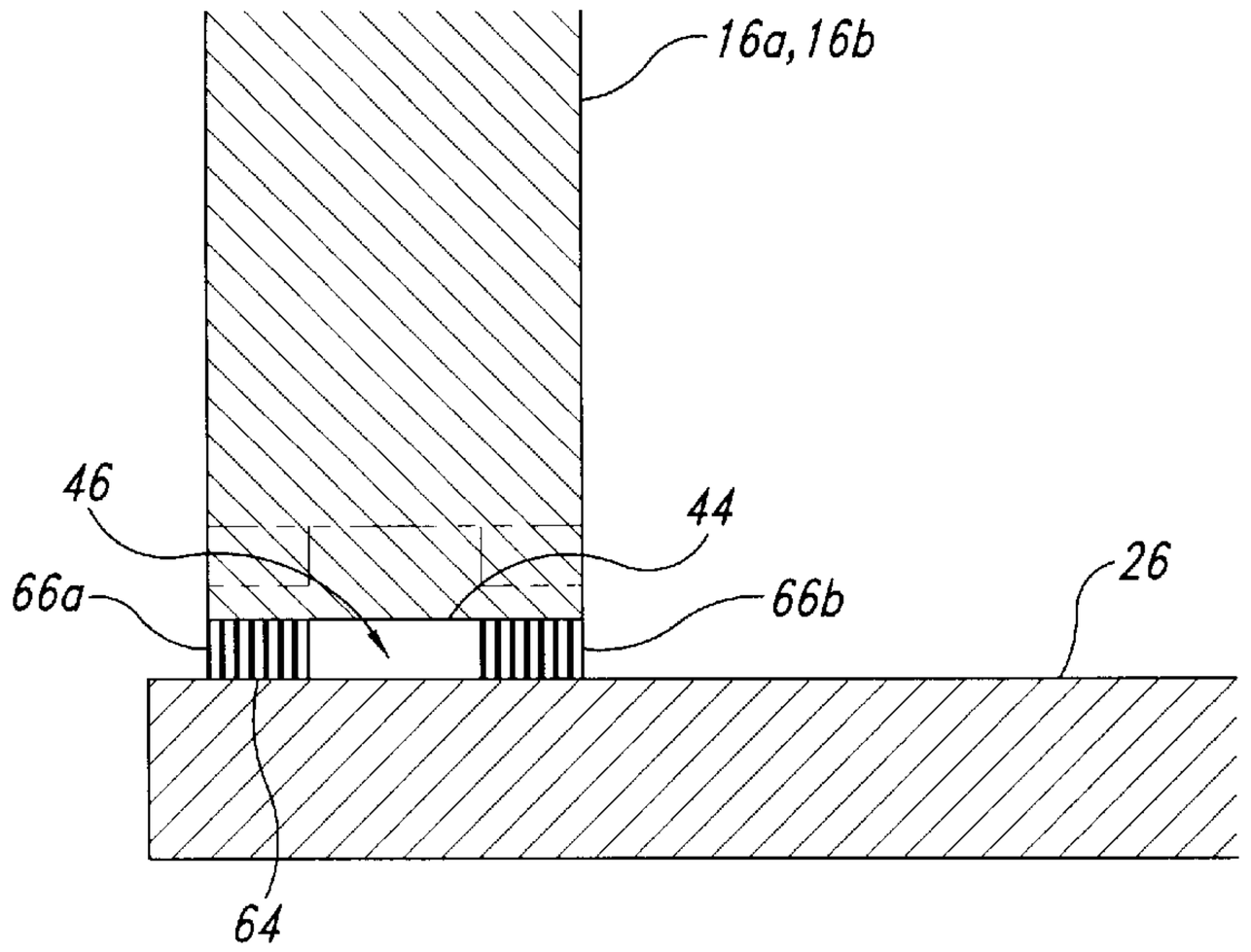


Fig. 5B



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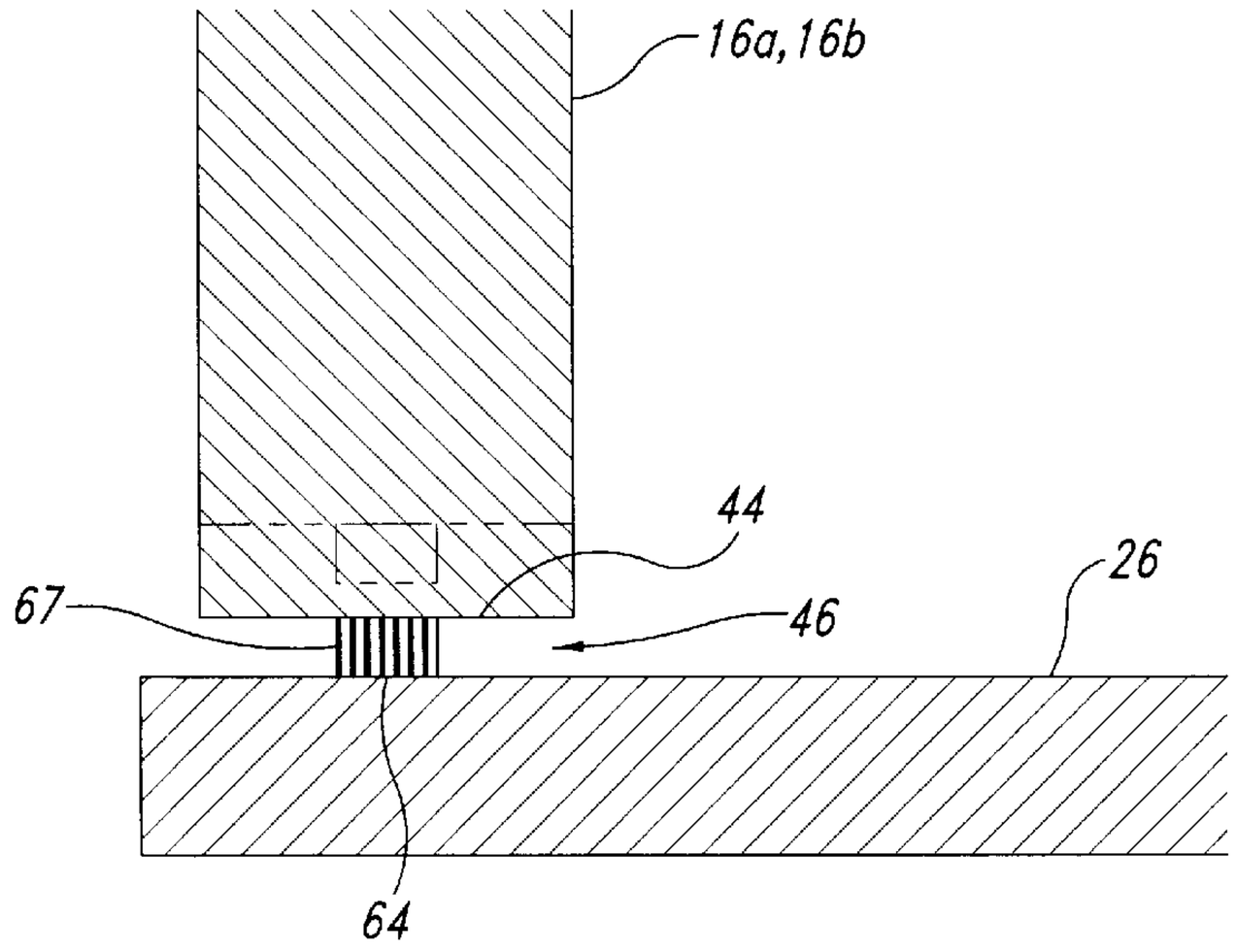

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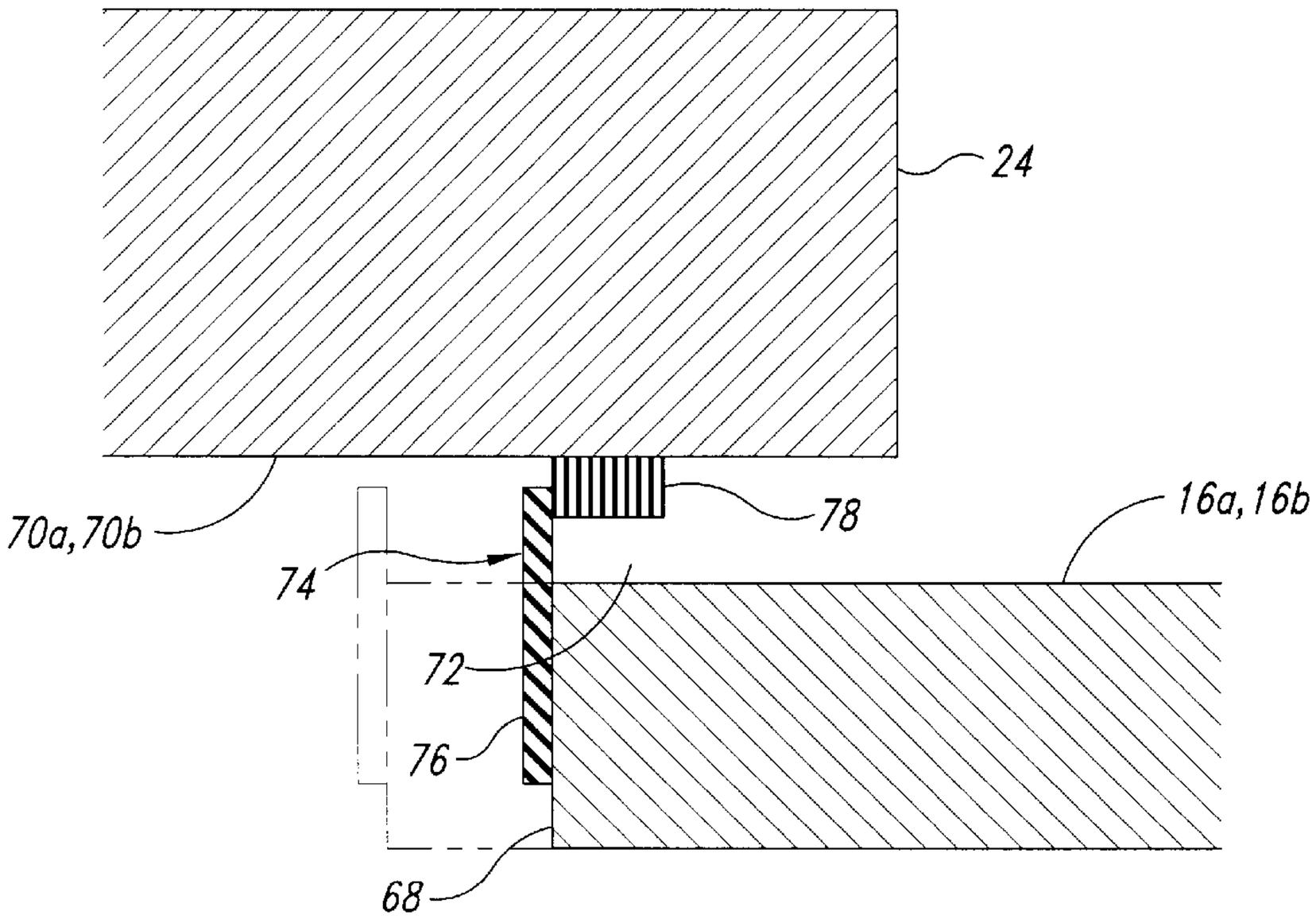

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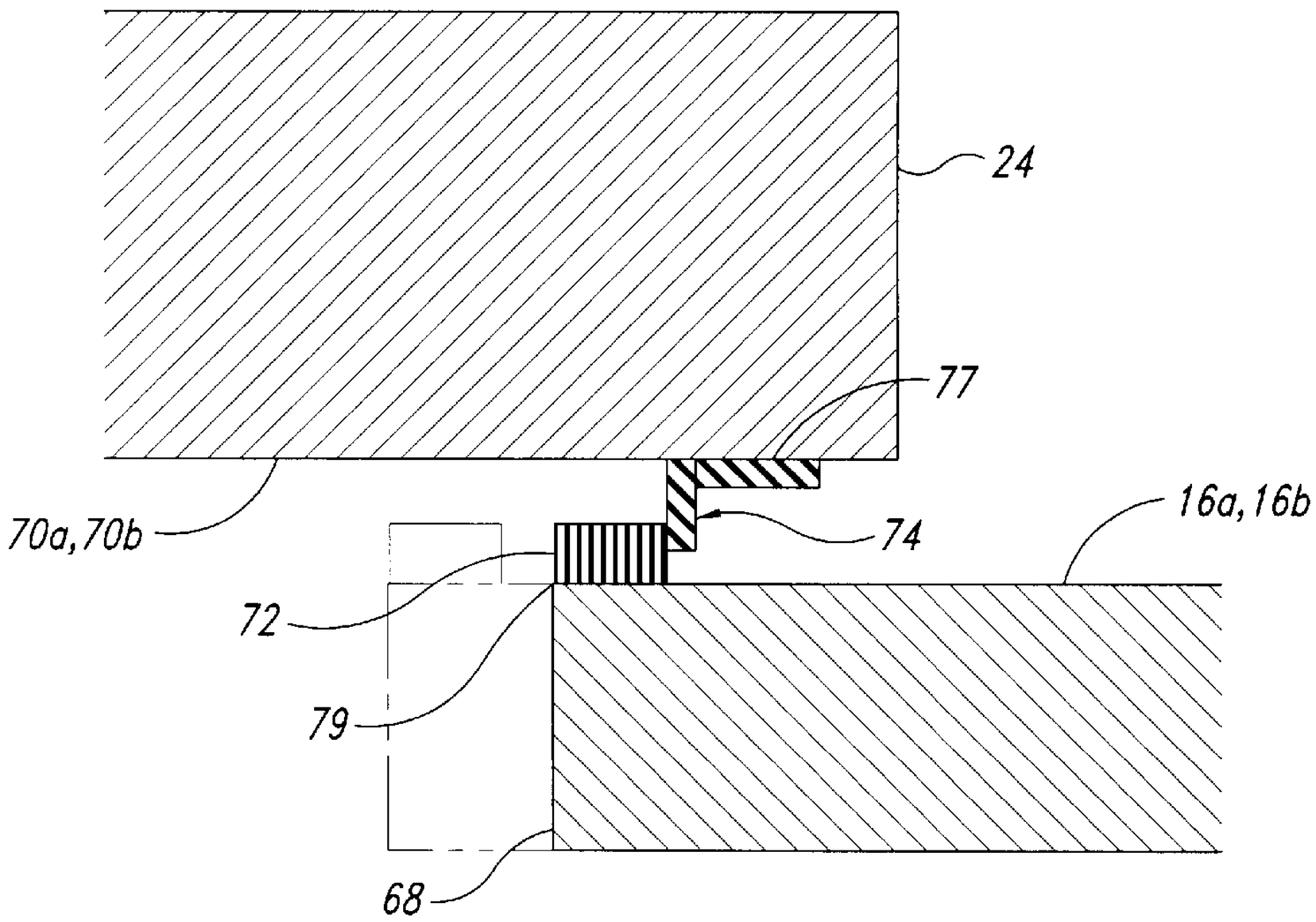

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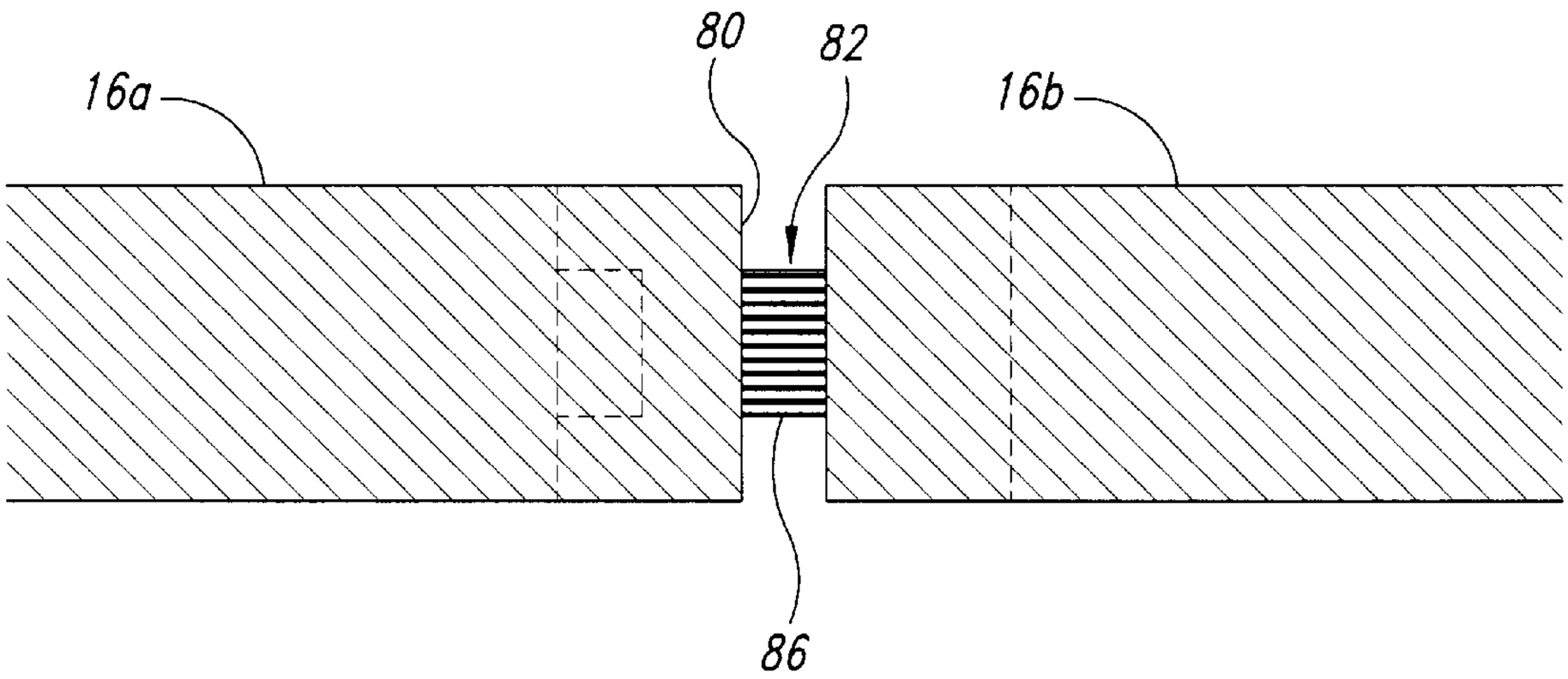

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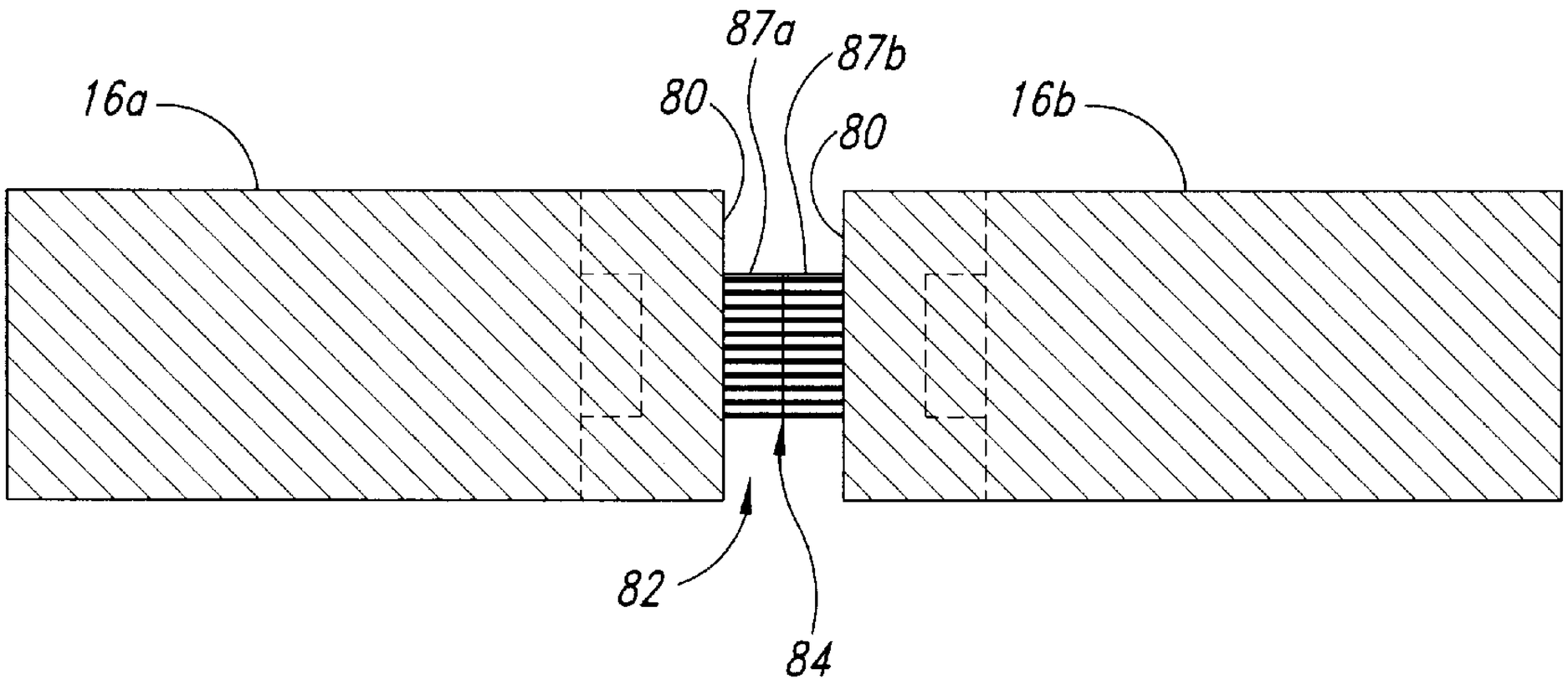

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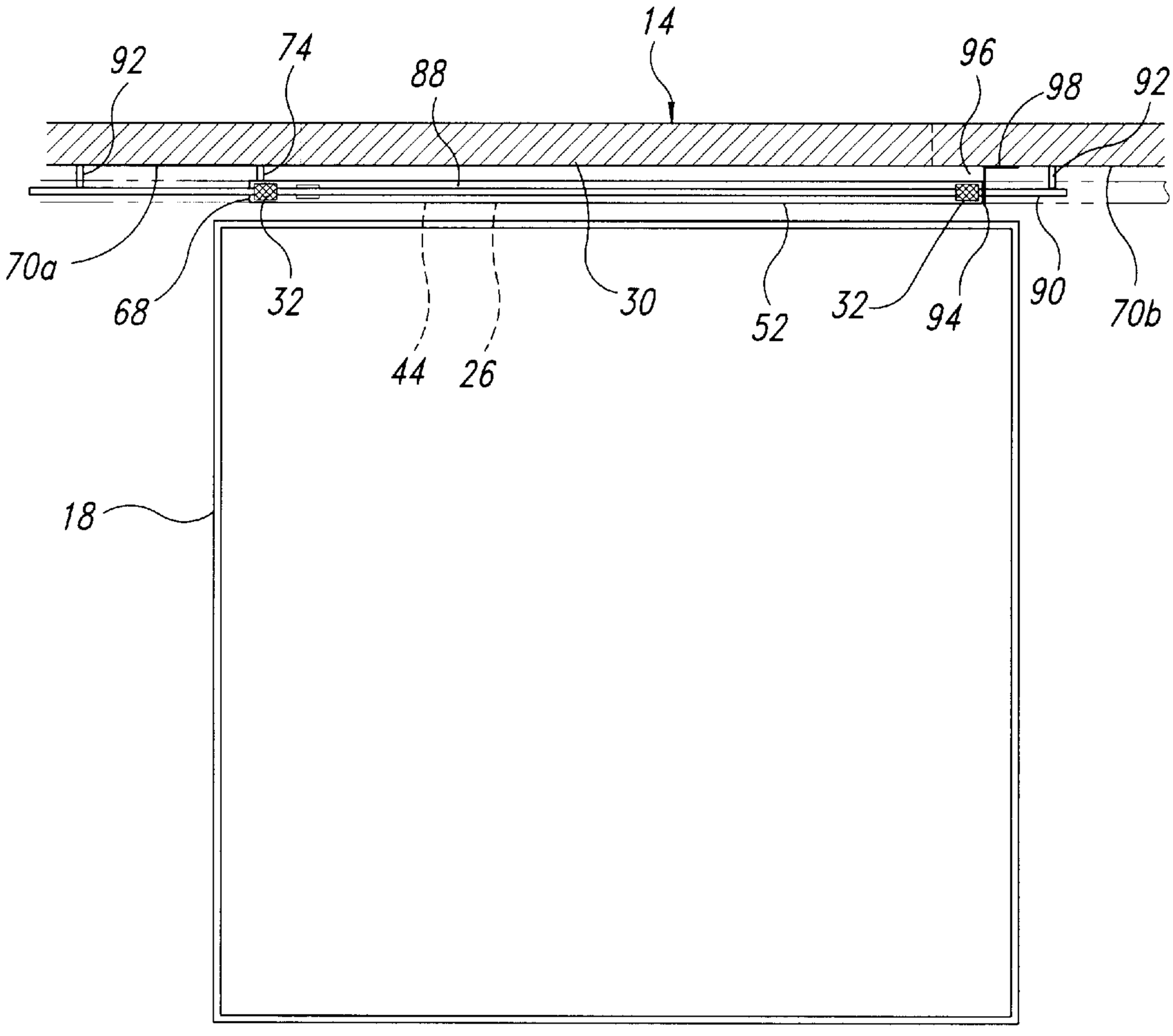

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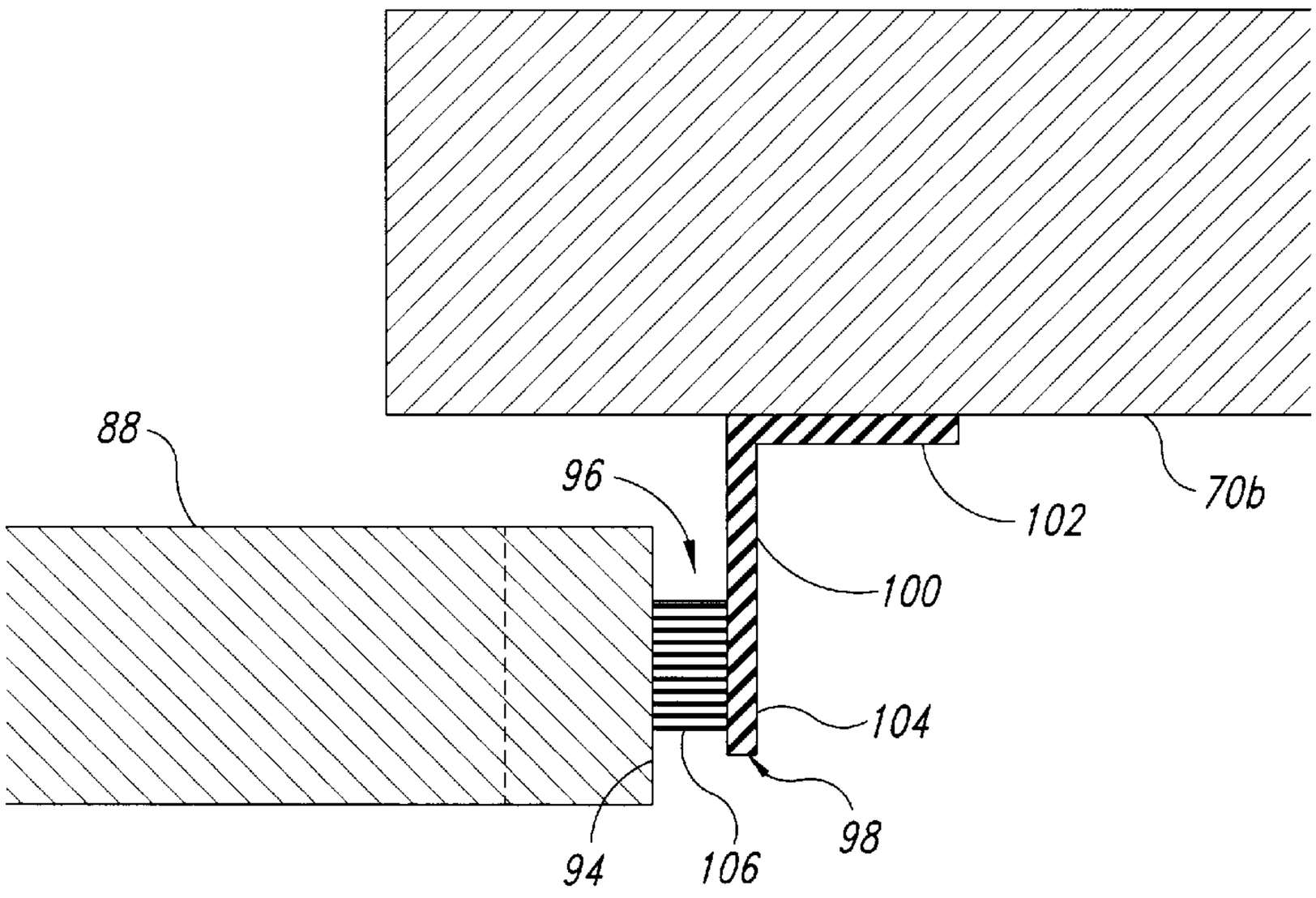

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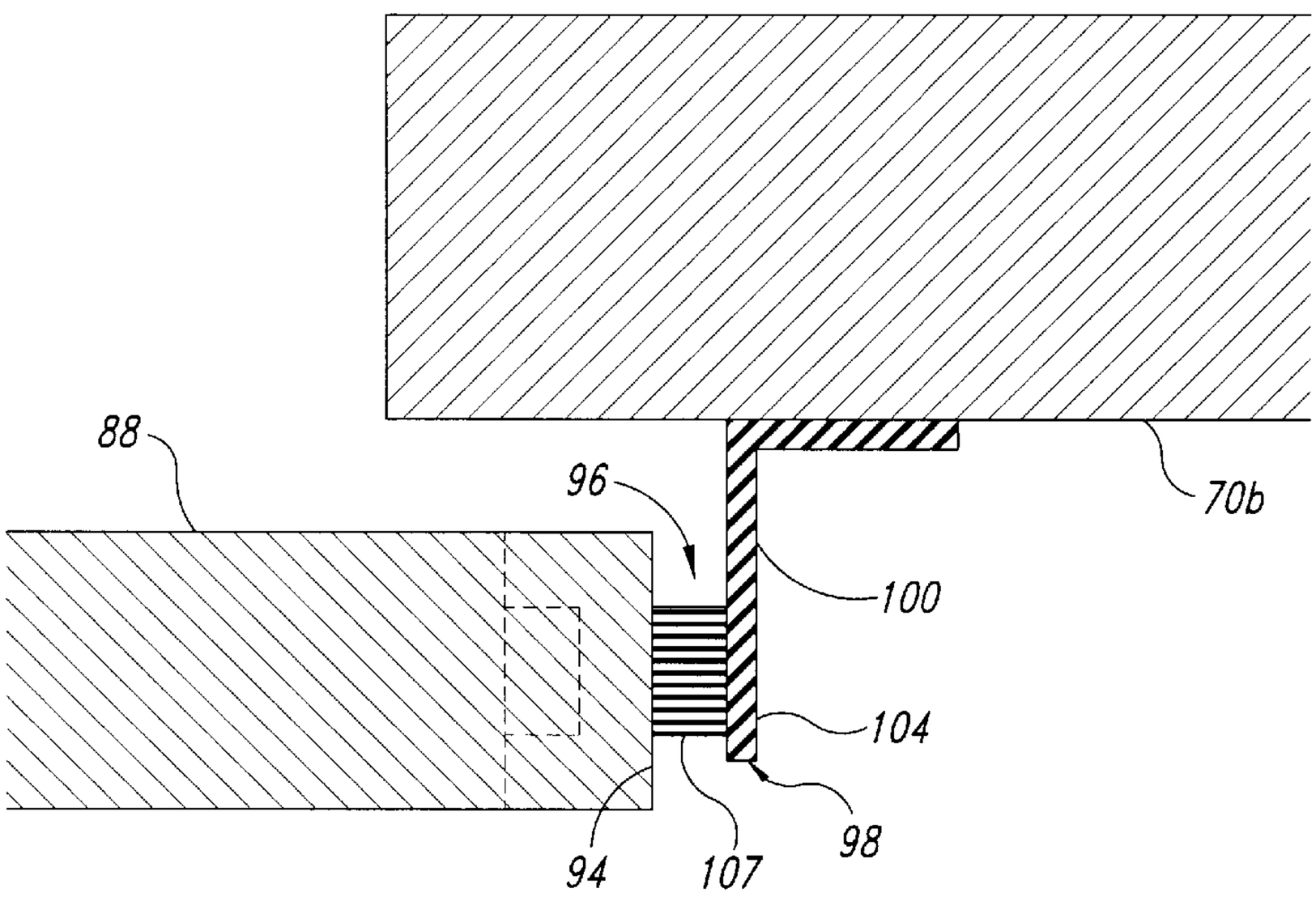

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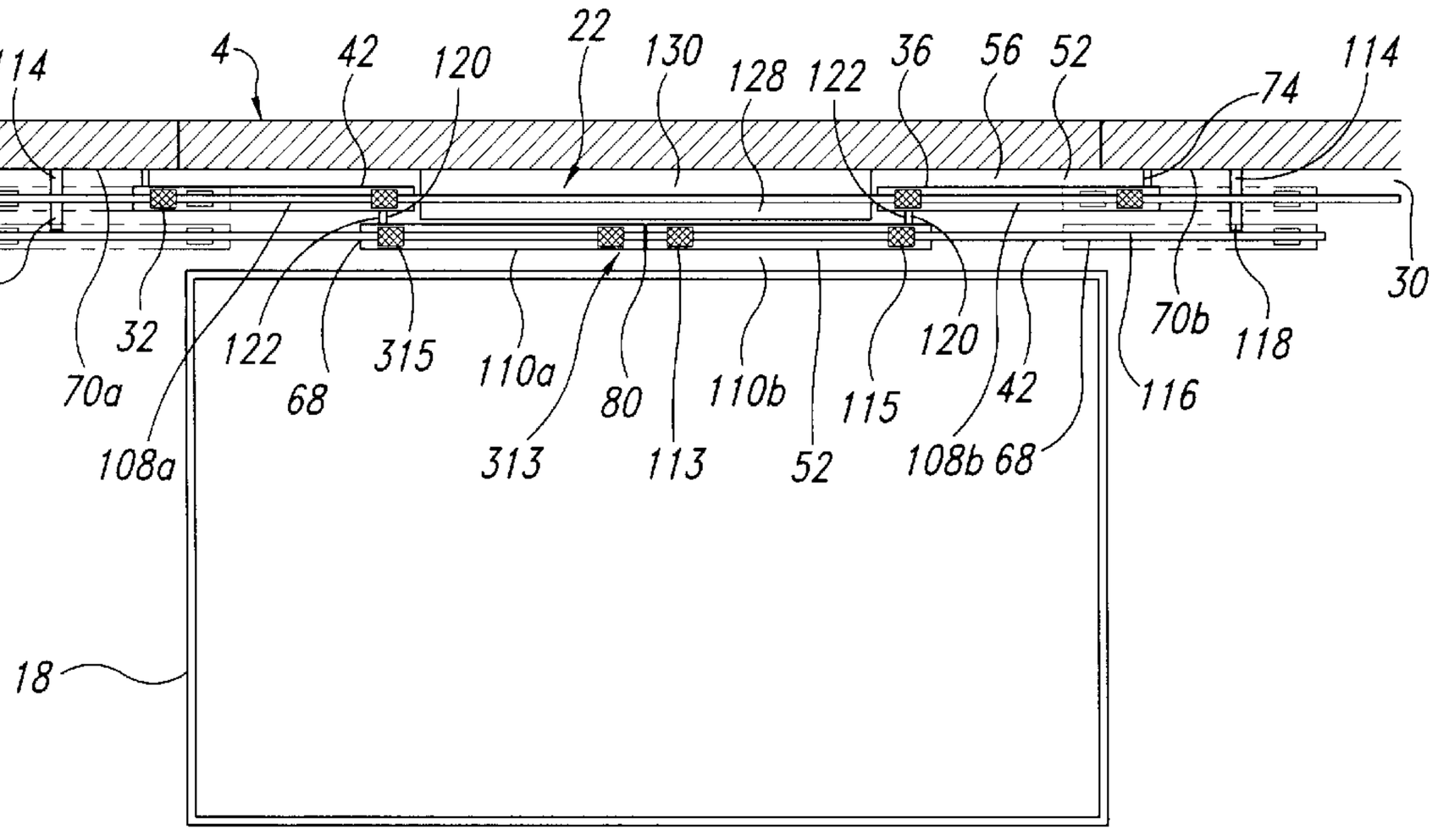

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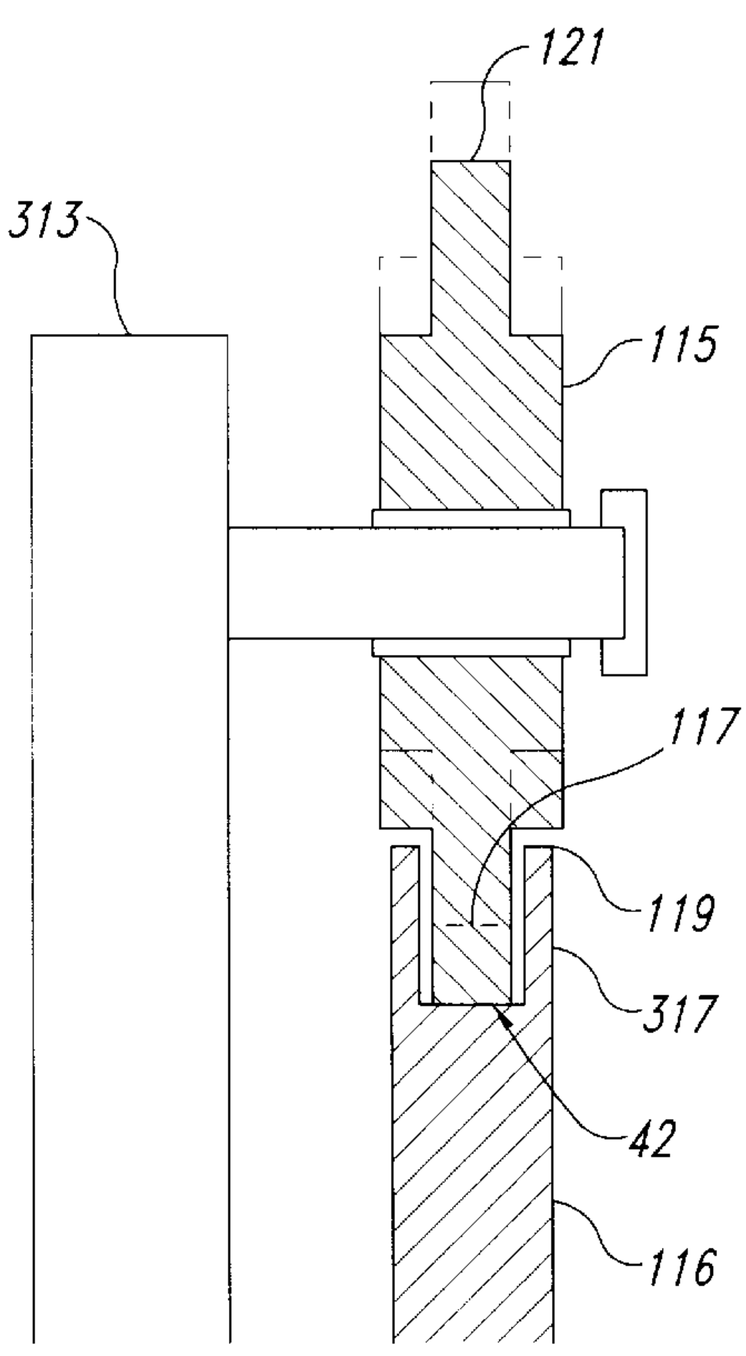

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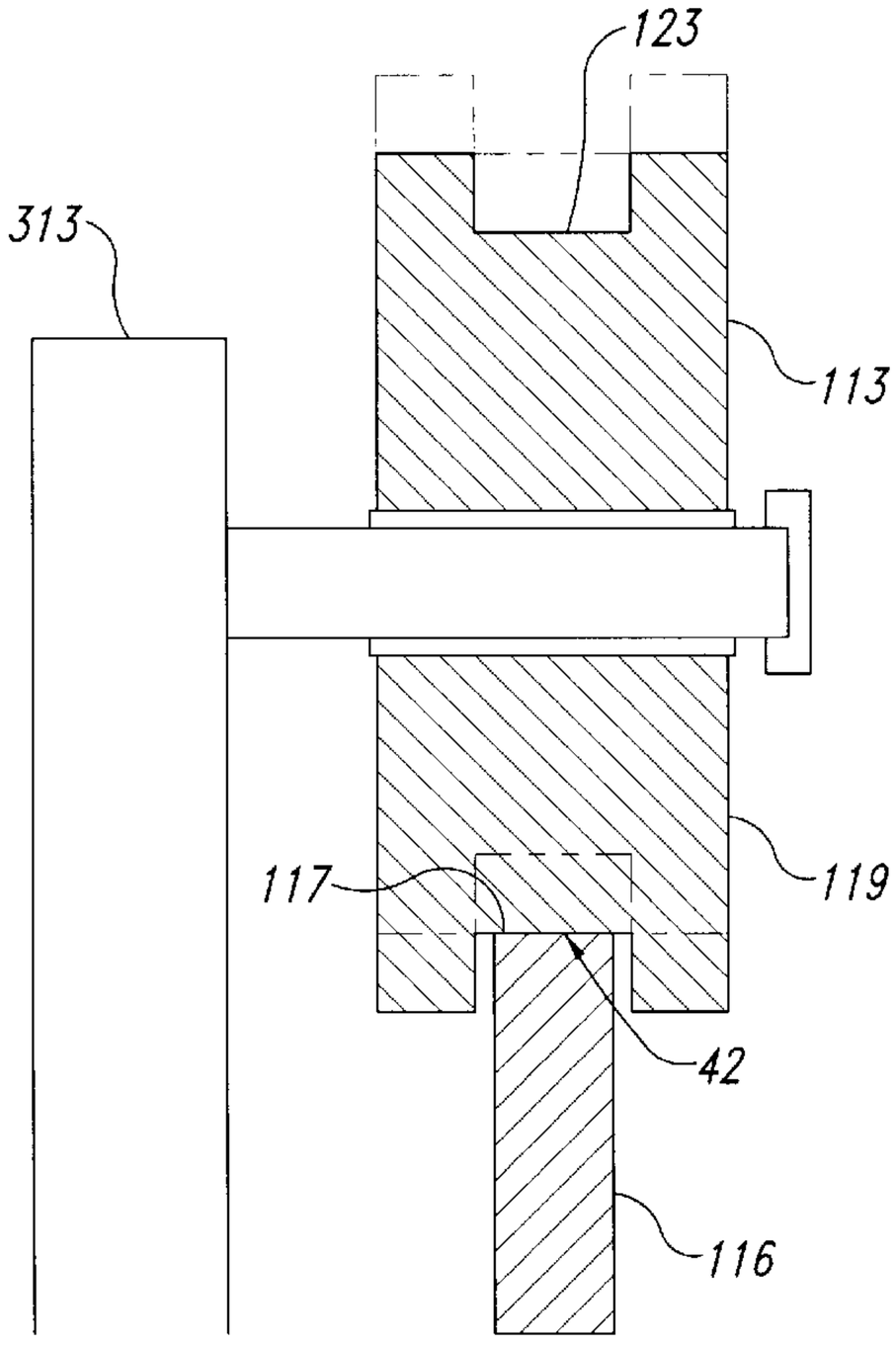

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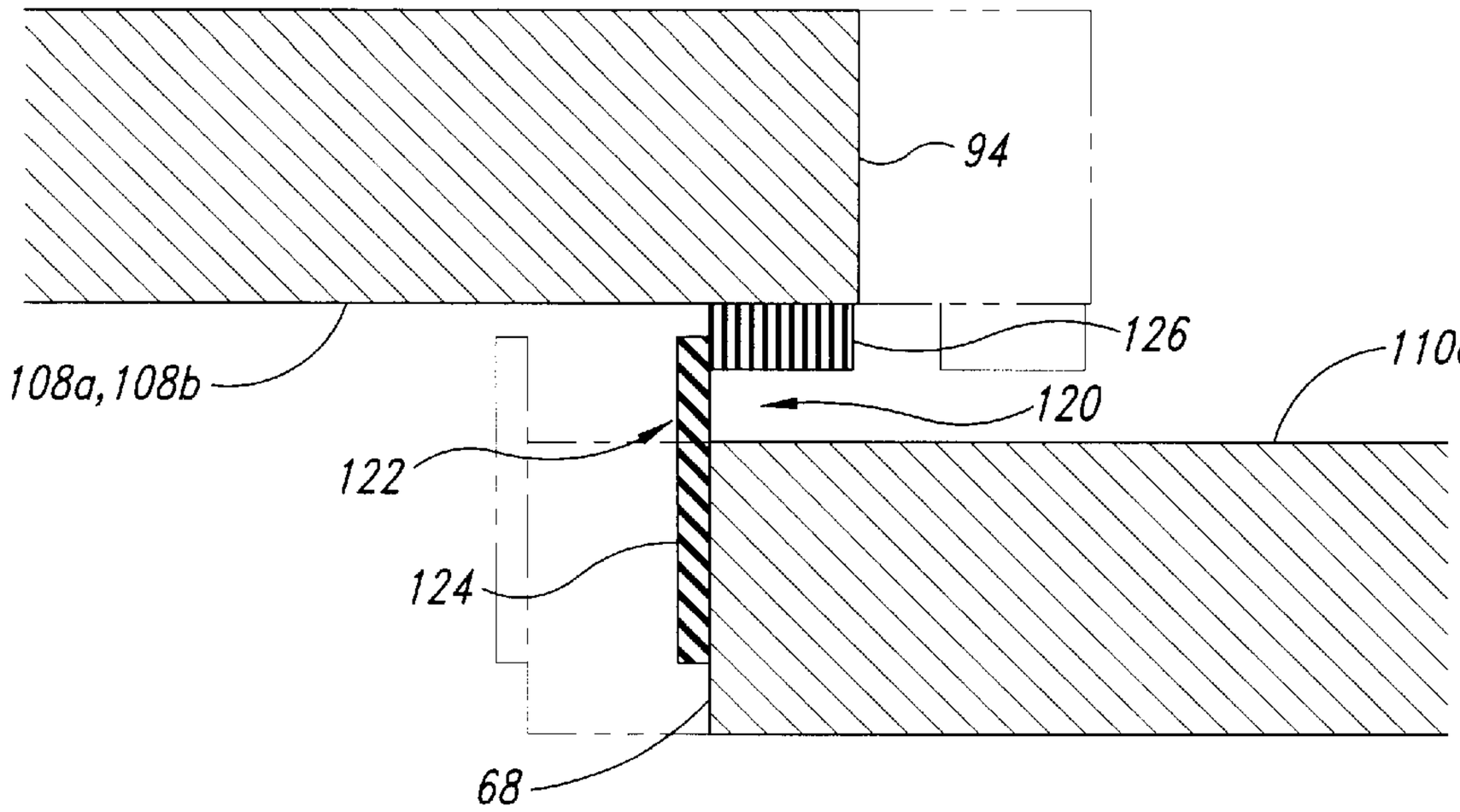

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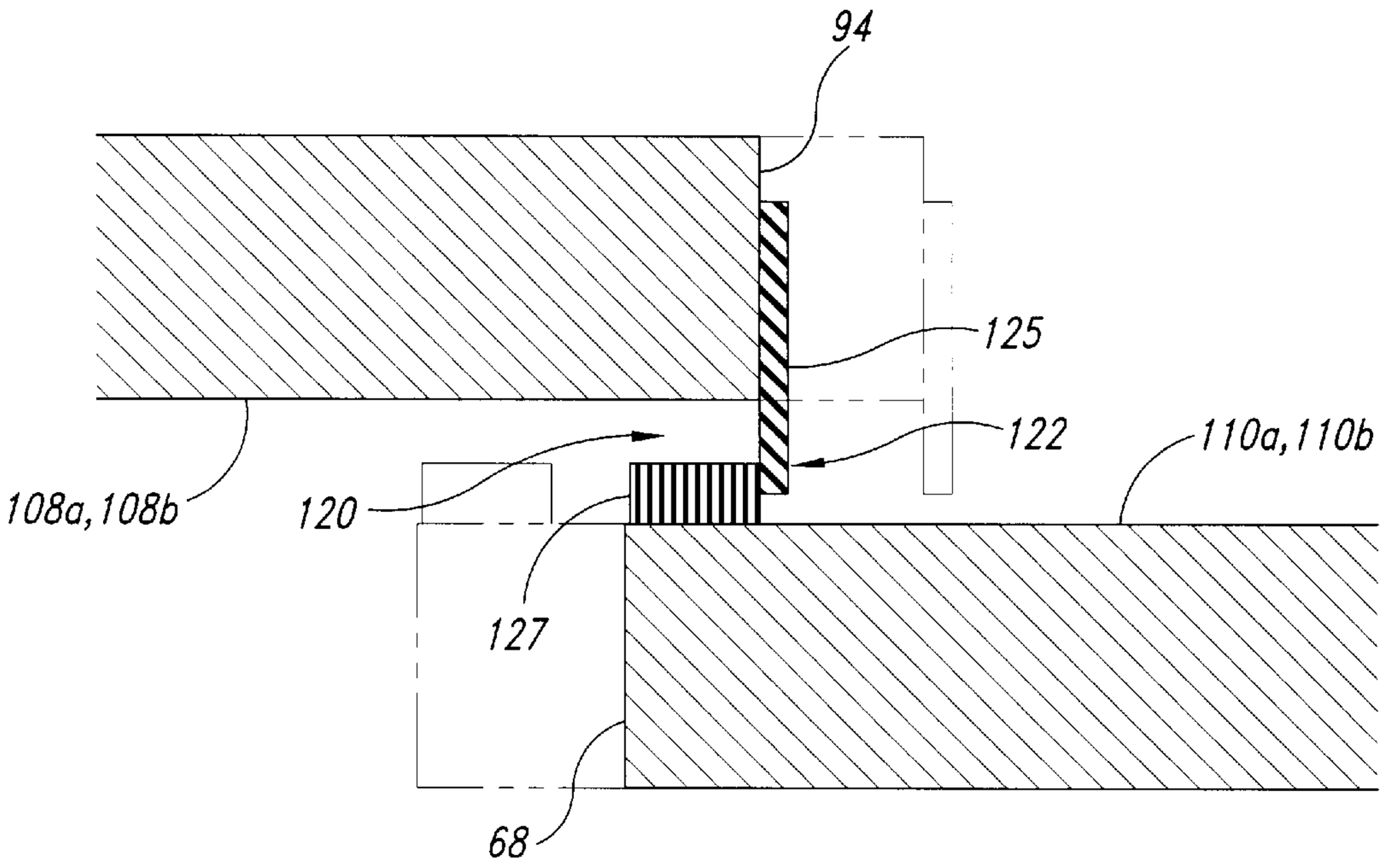

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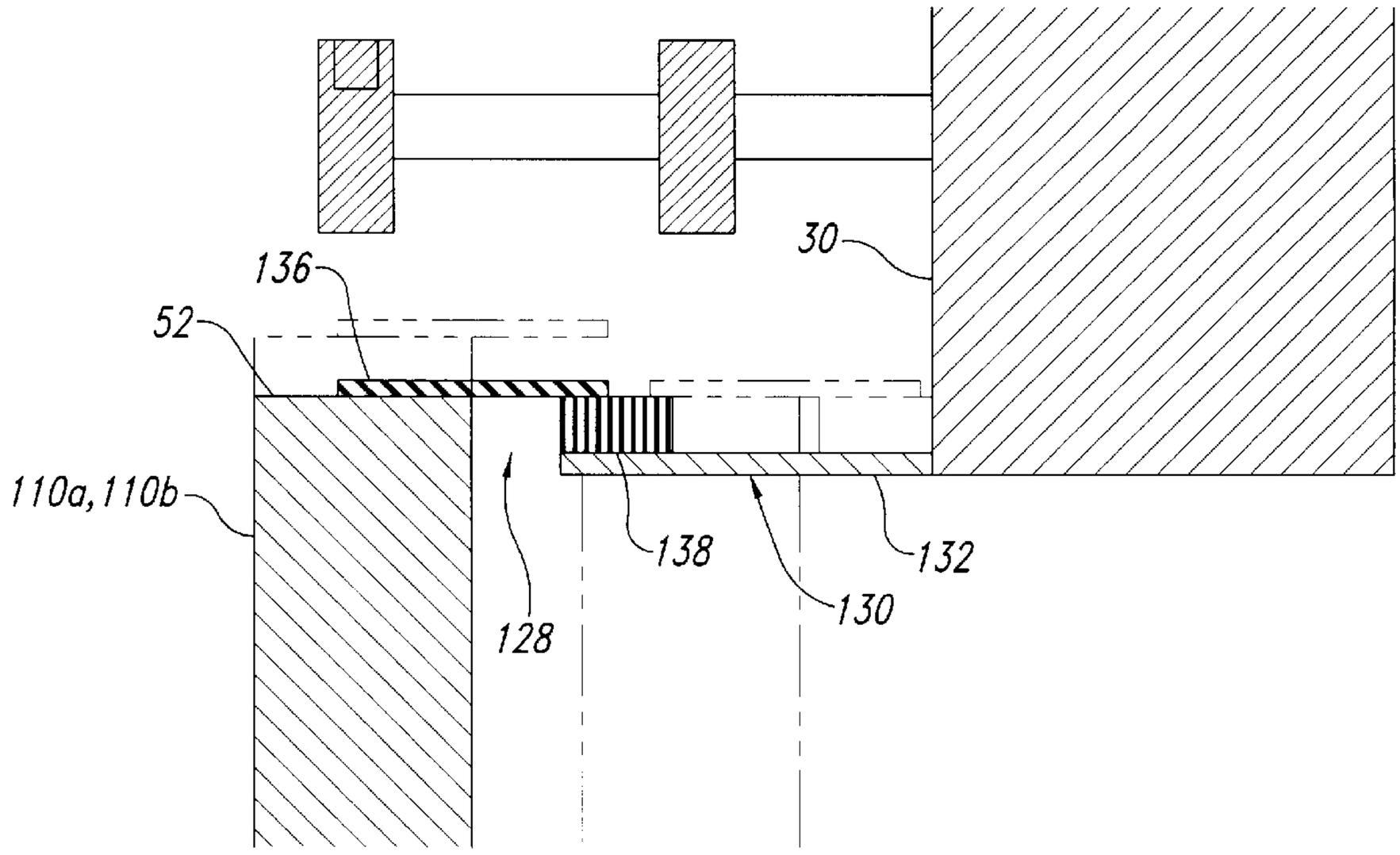

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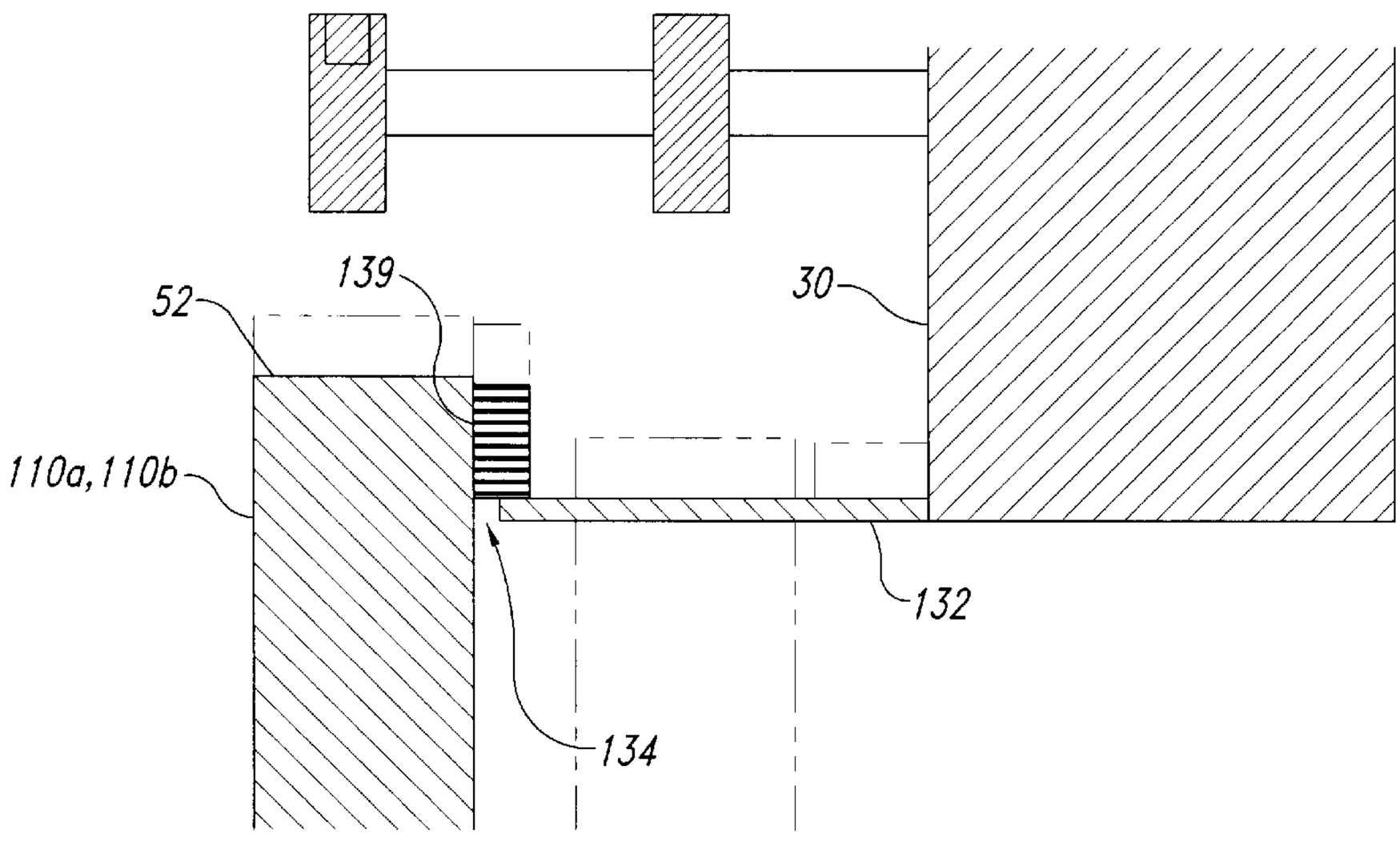

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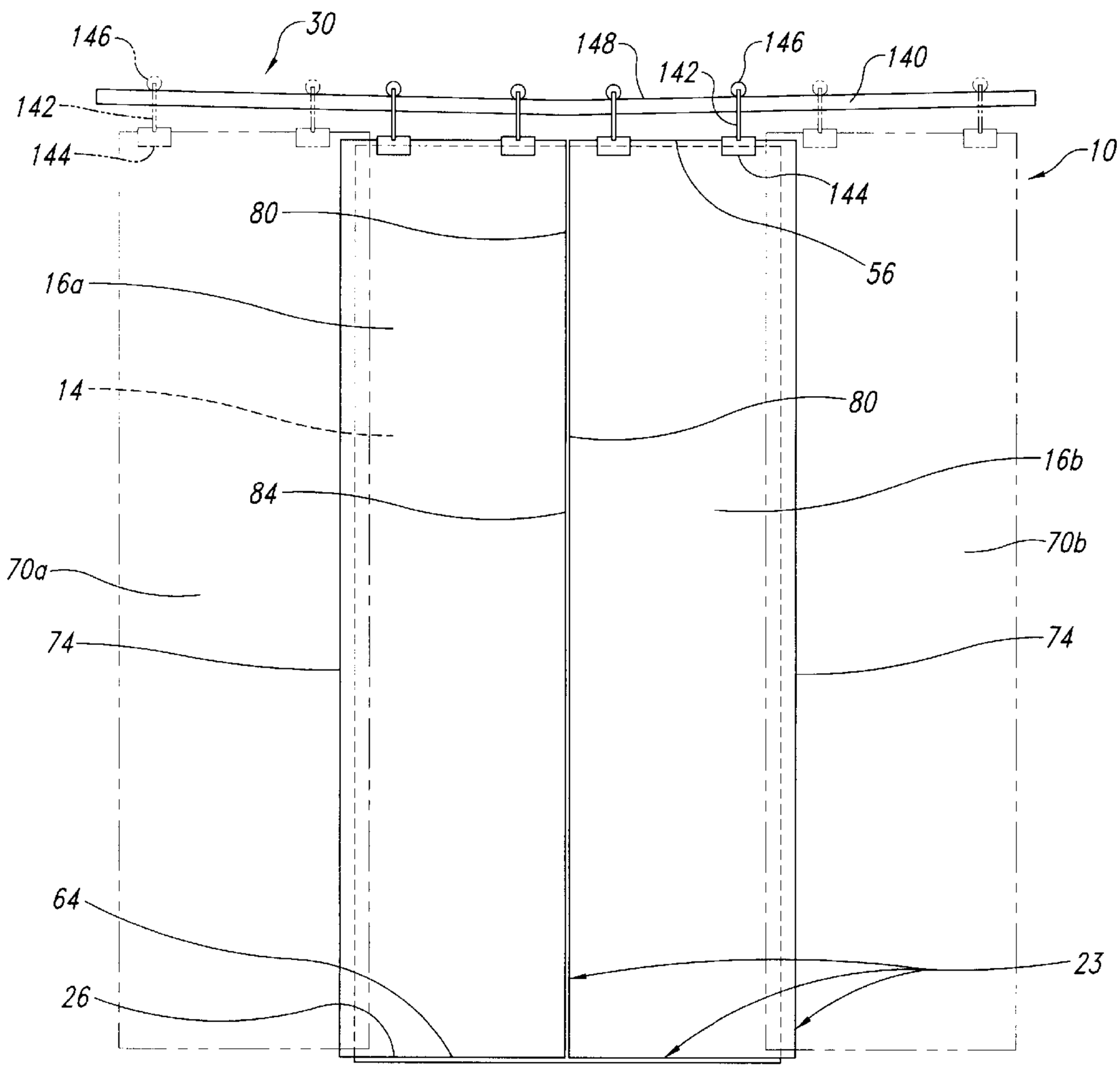
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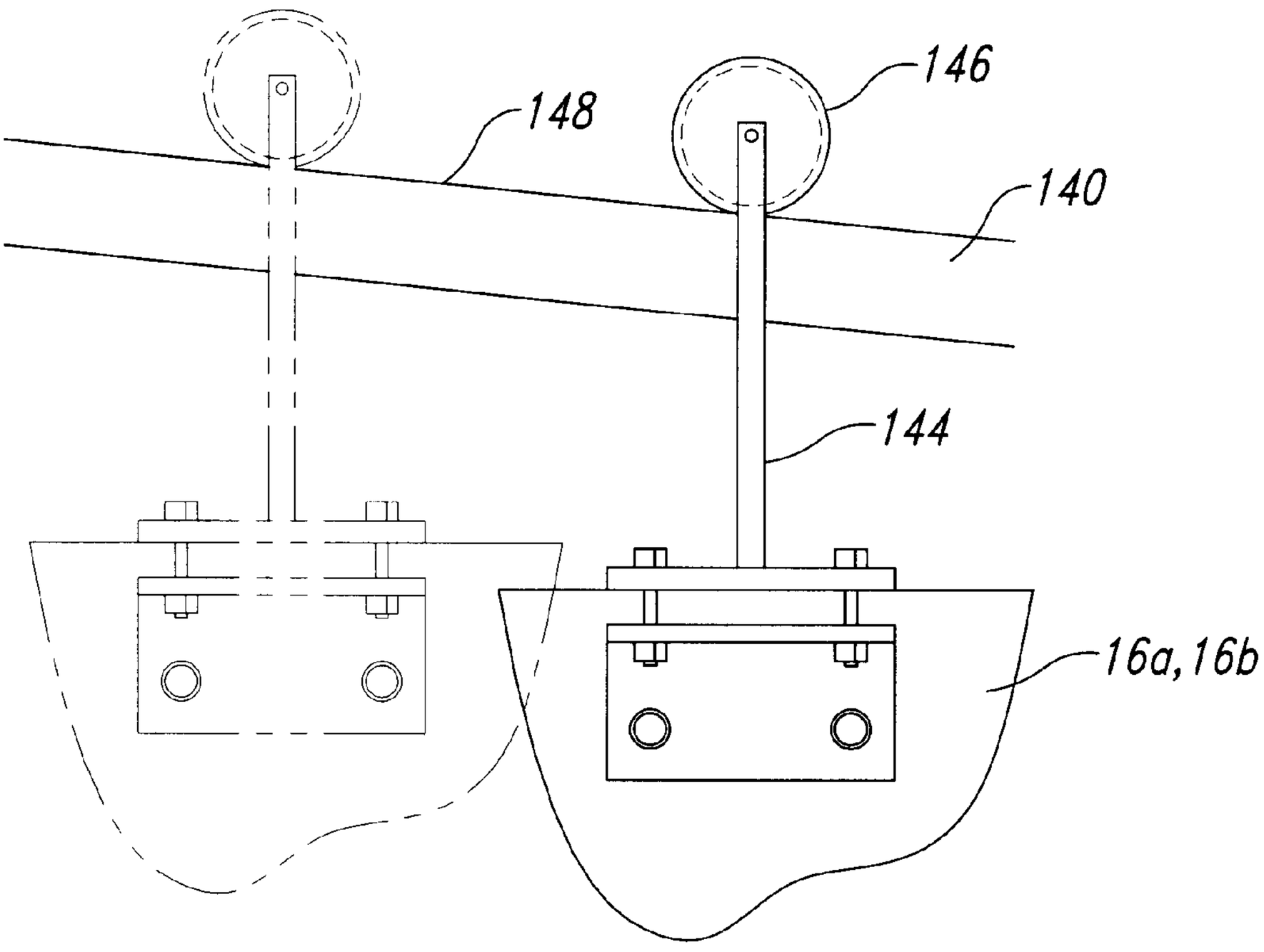
Fig. 14



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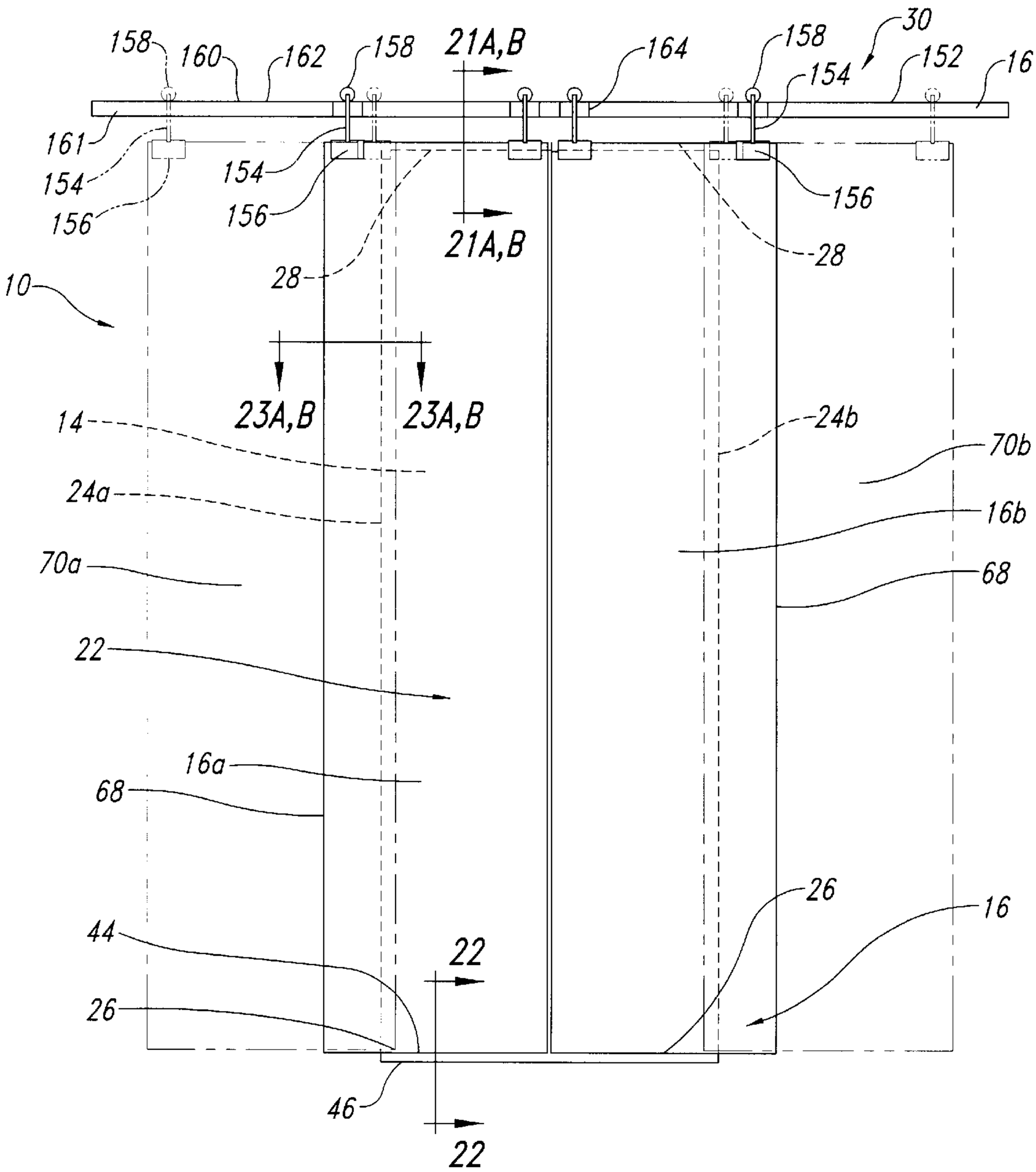
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Fig. 16

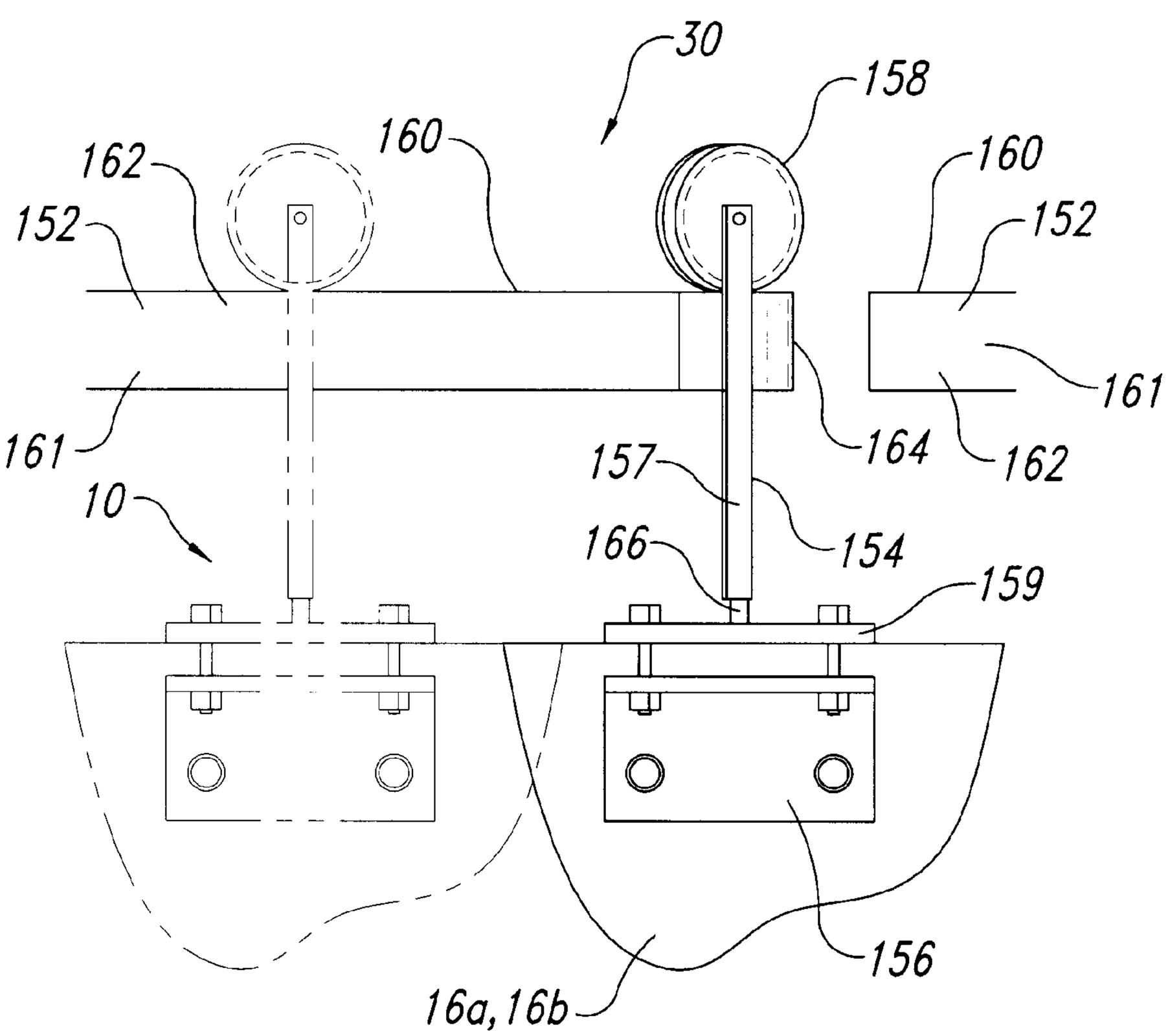
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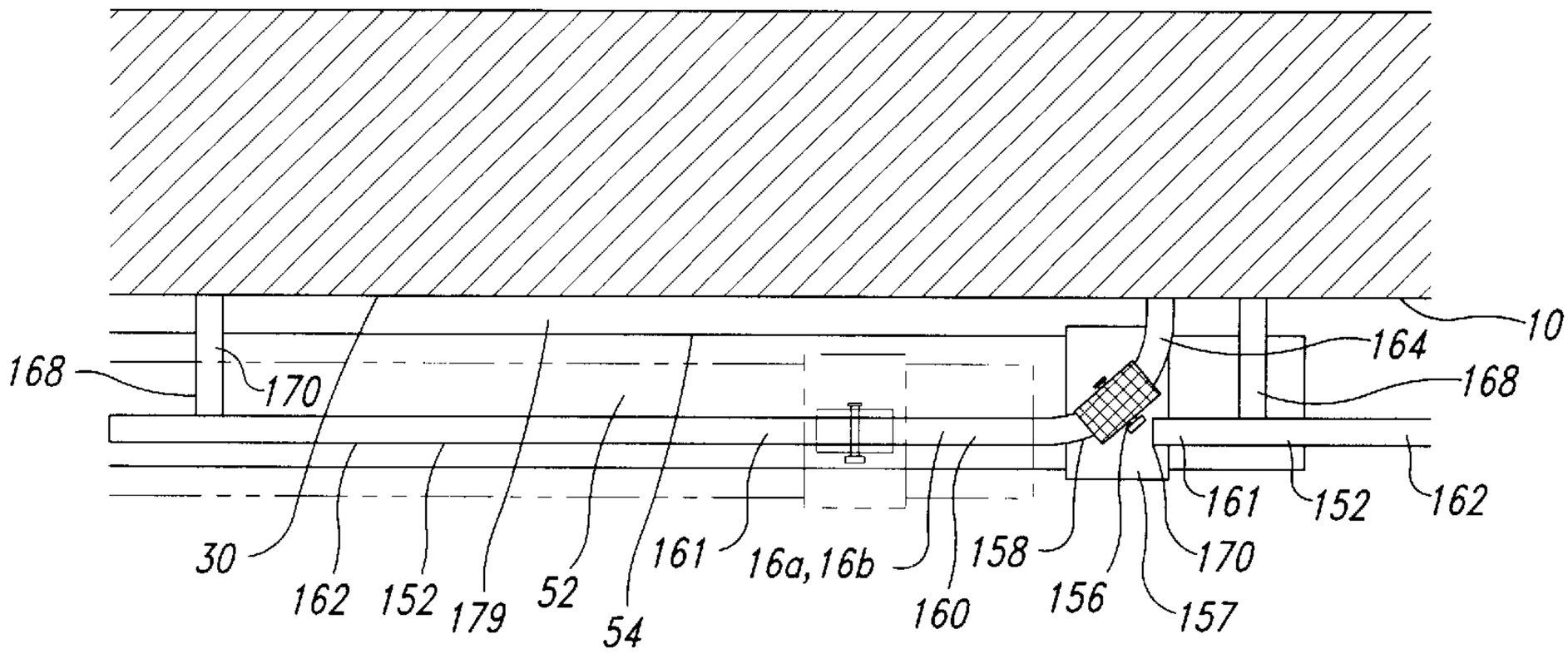
Fig. 17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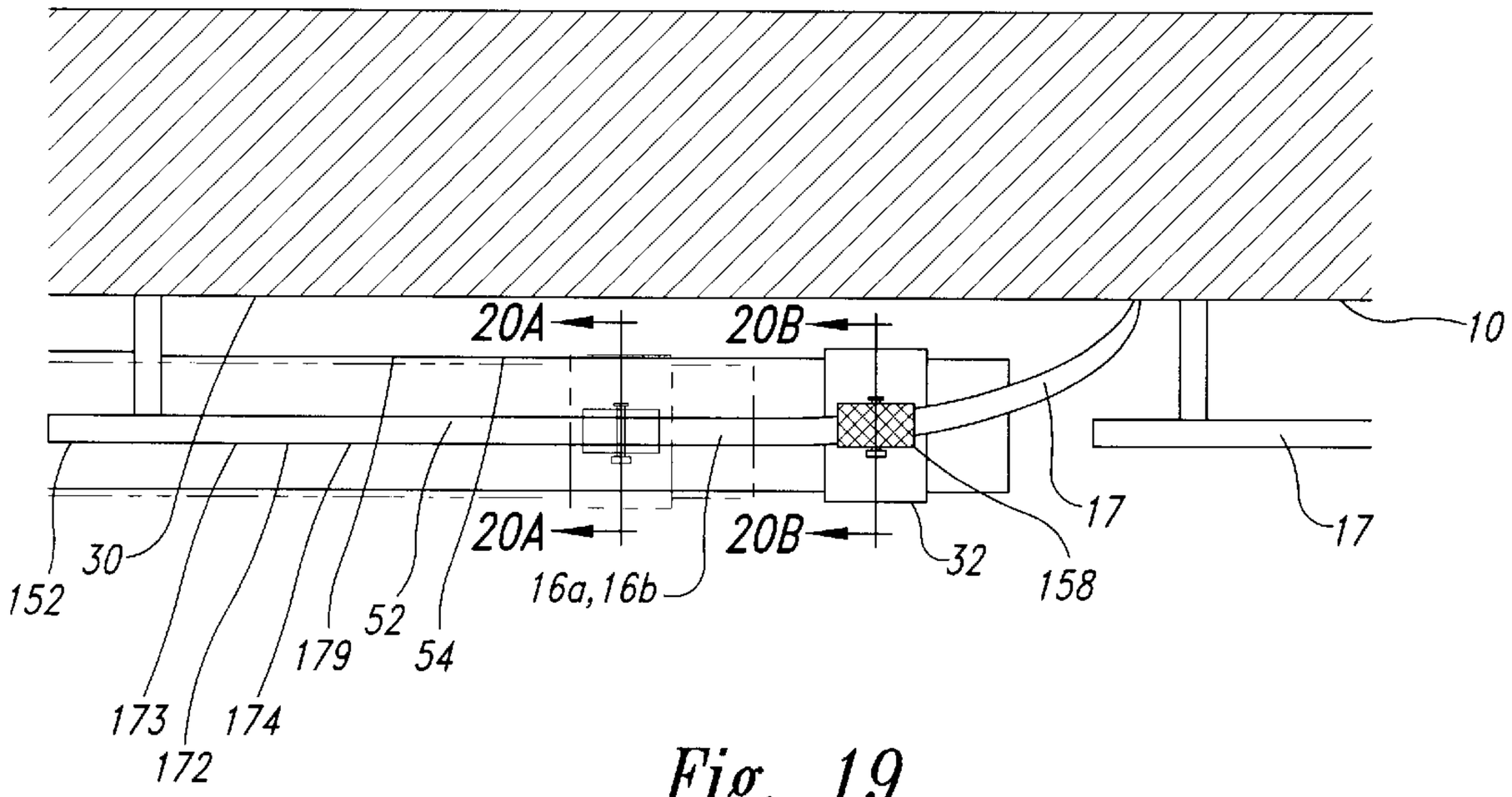
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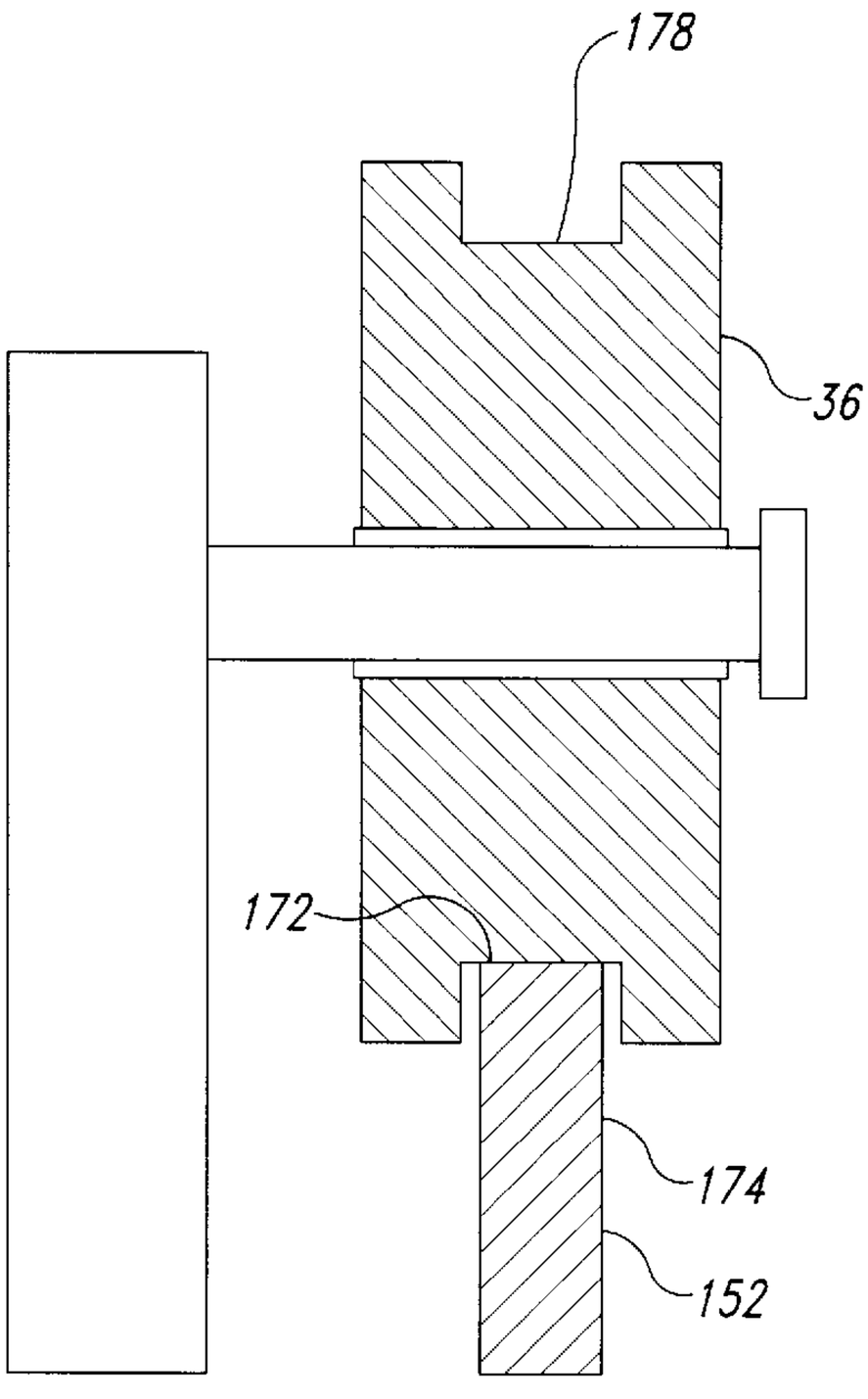
Fig. 19



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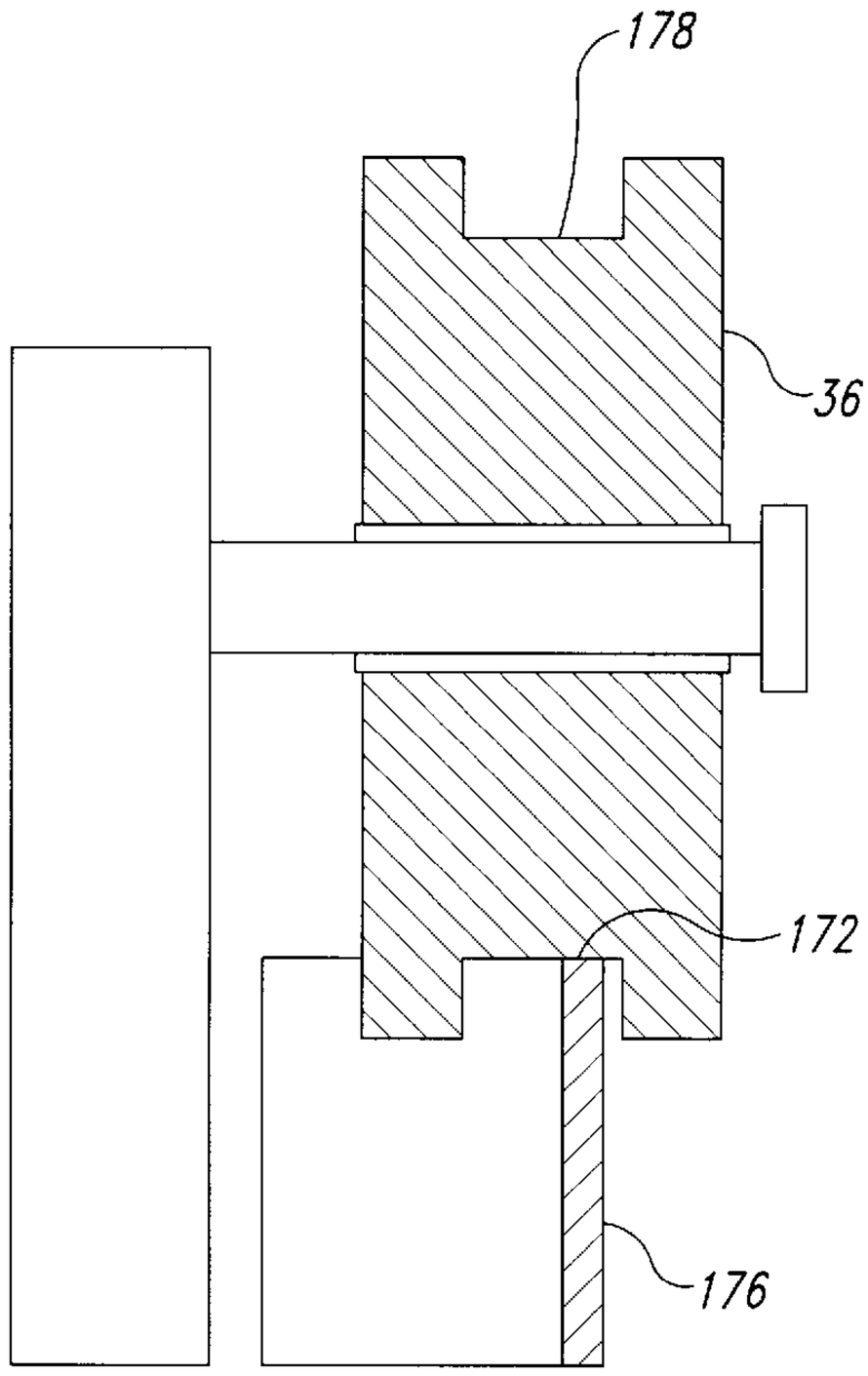

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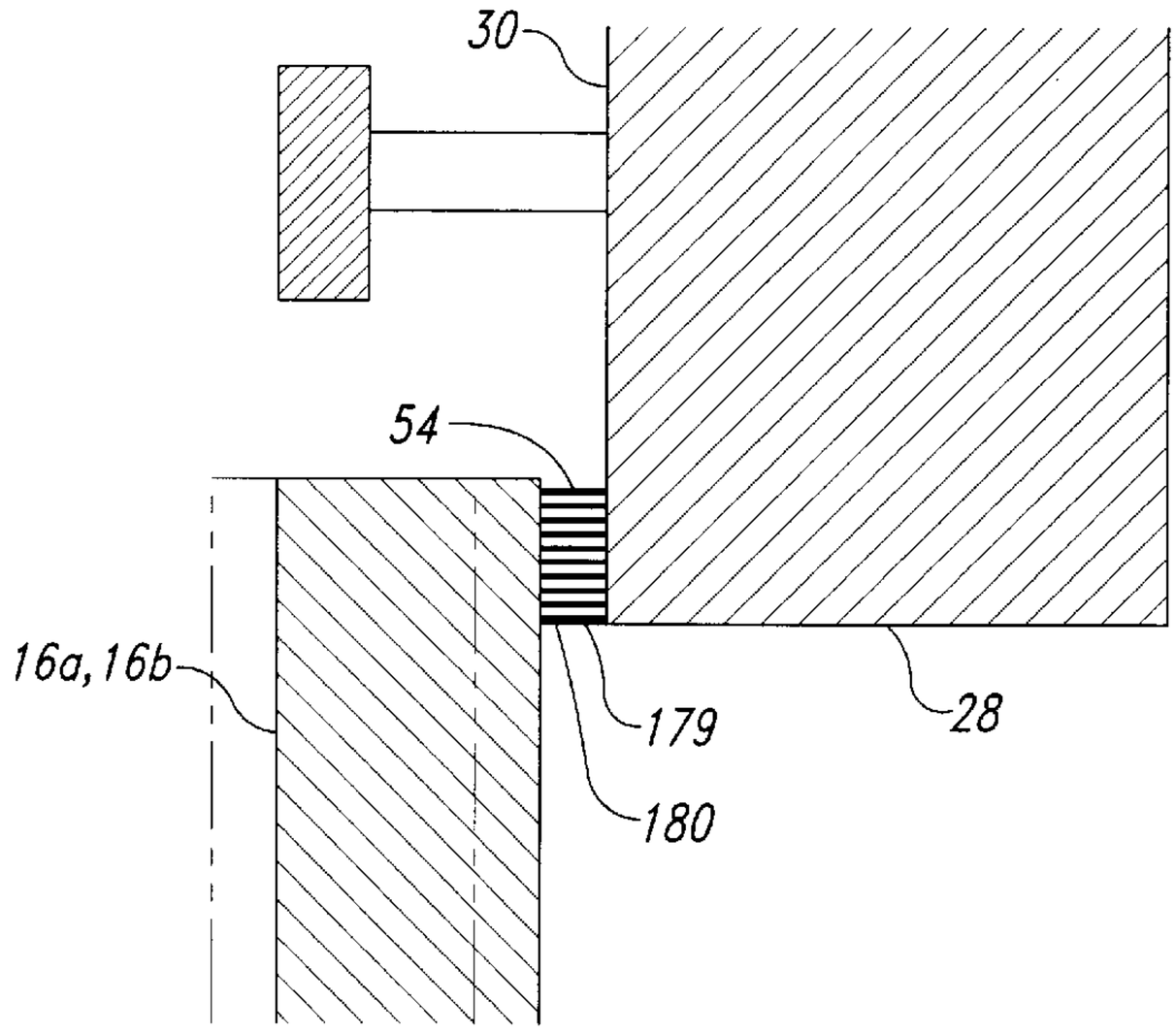

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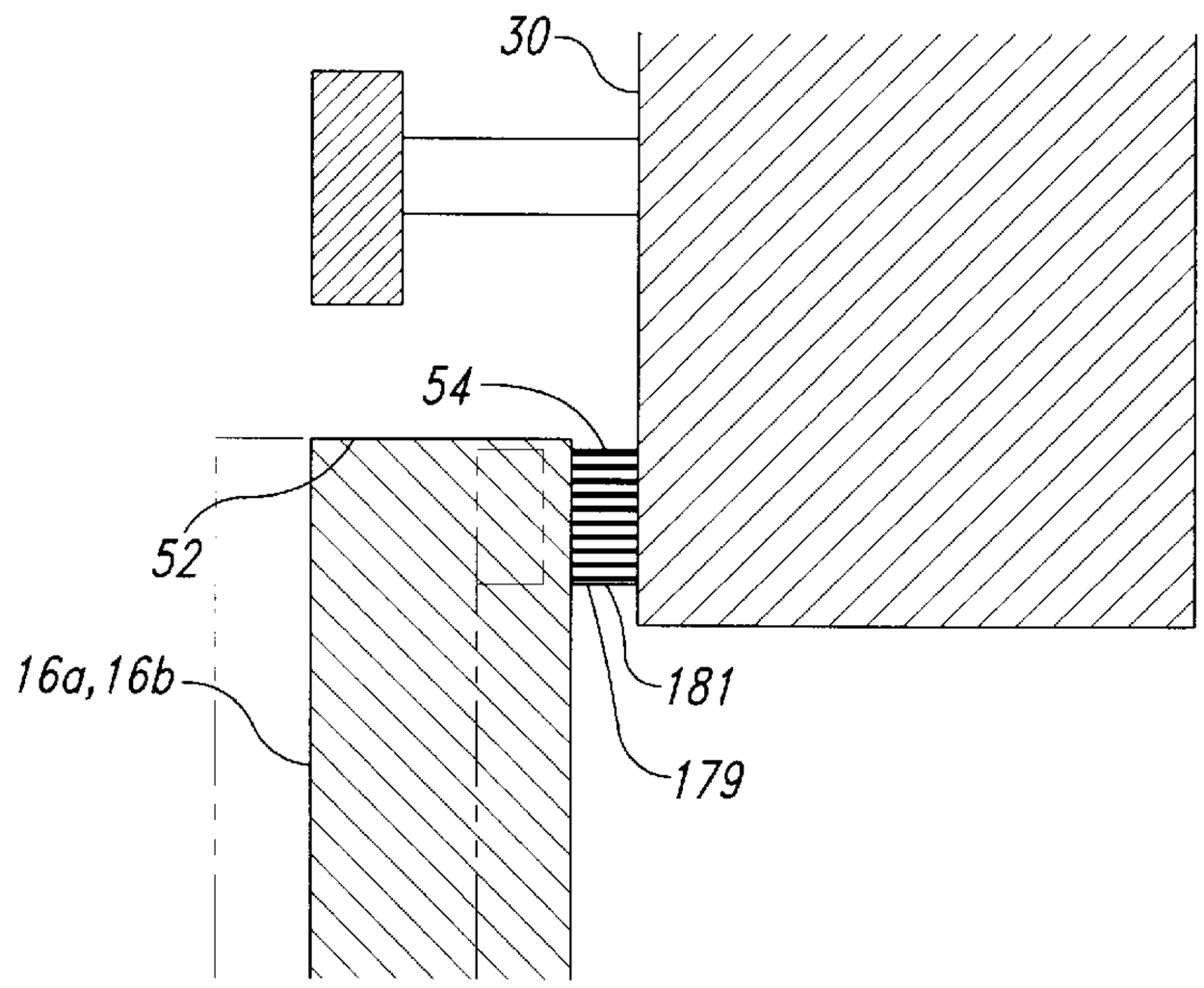

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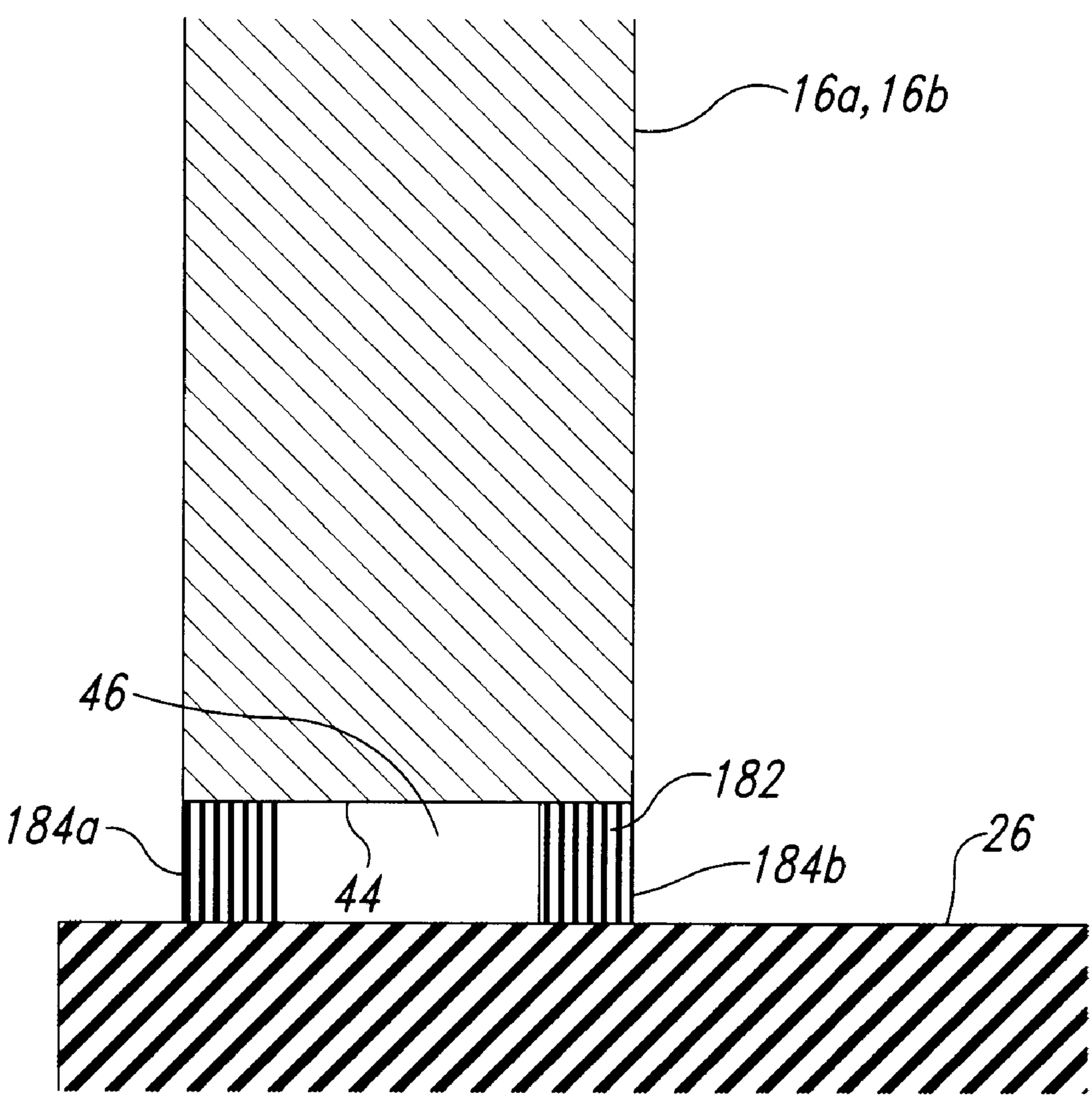

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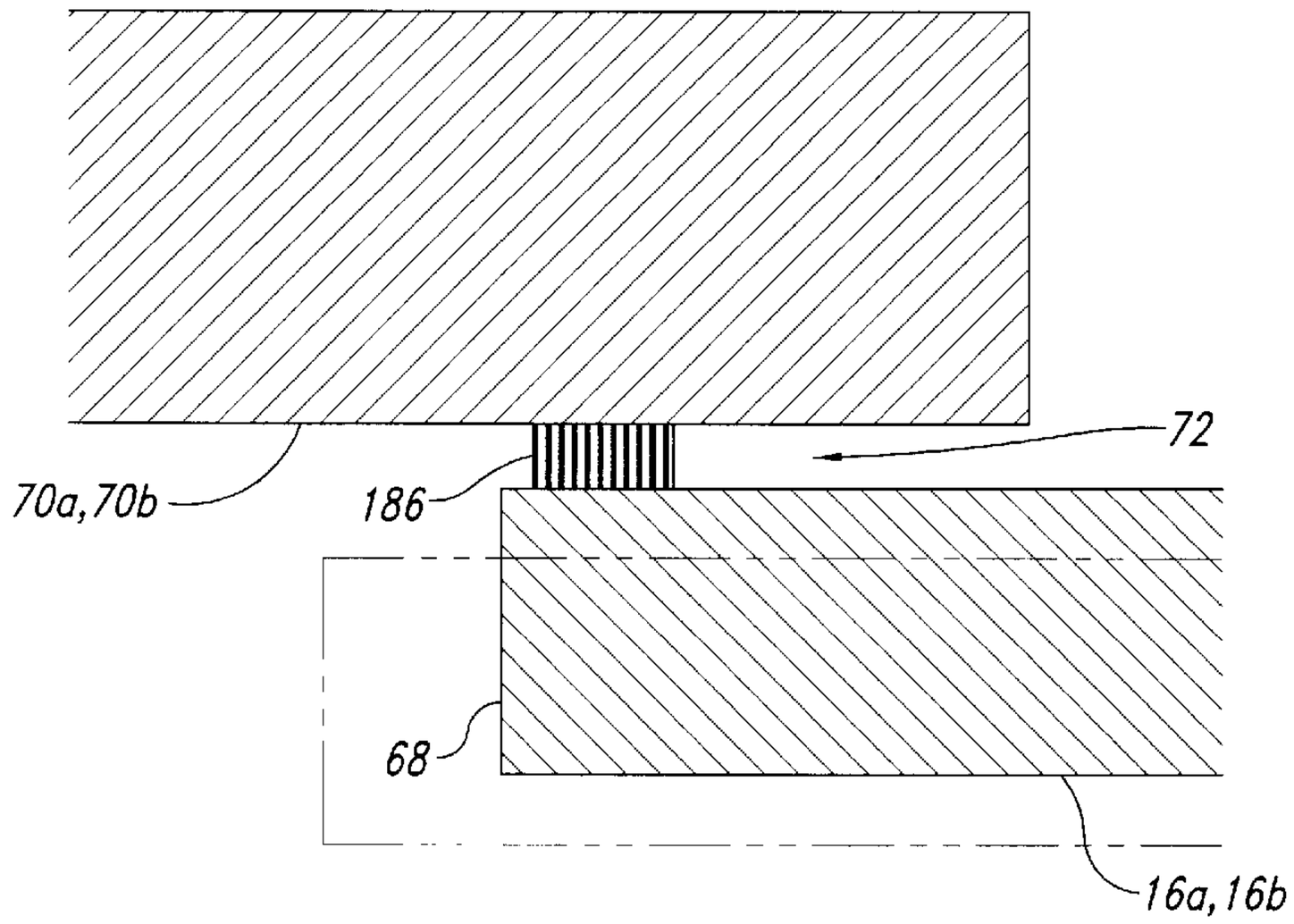

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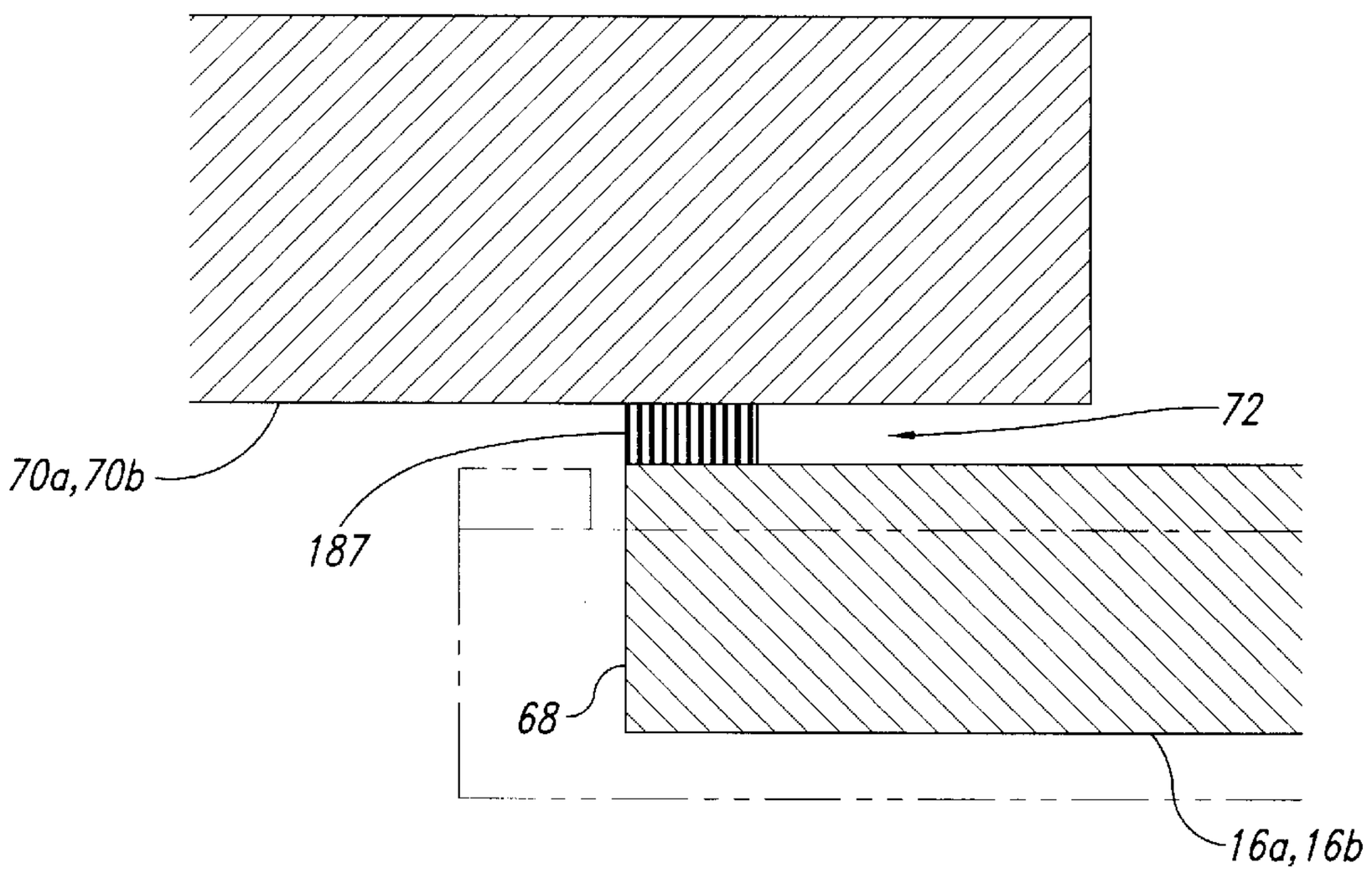

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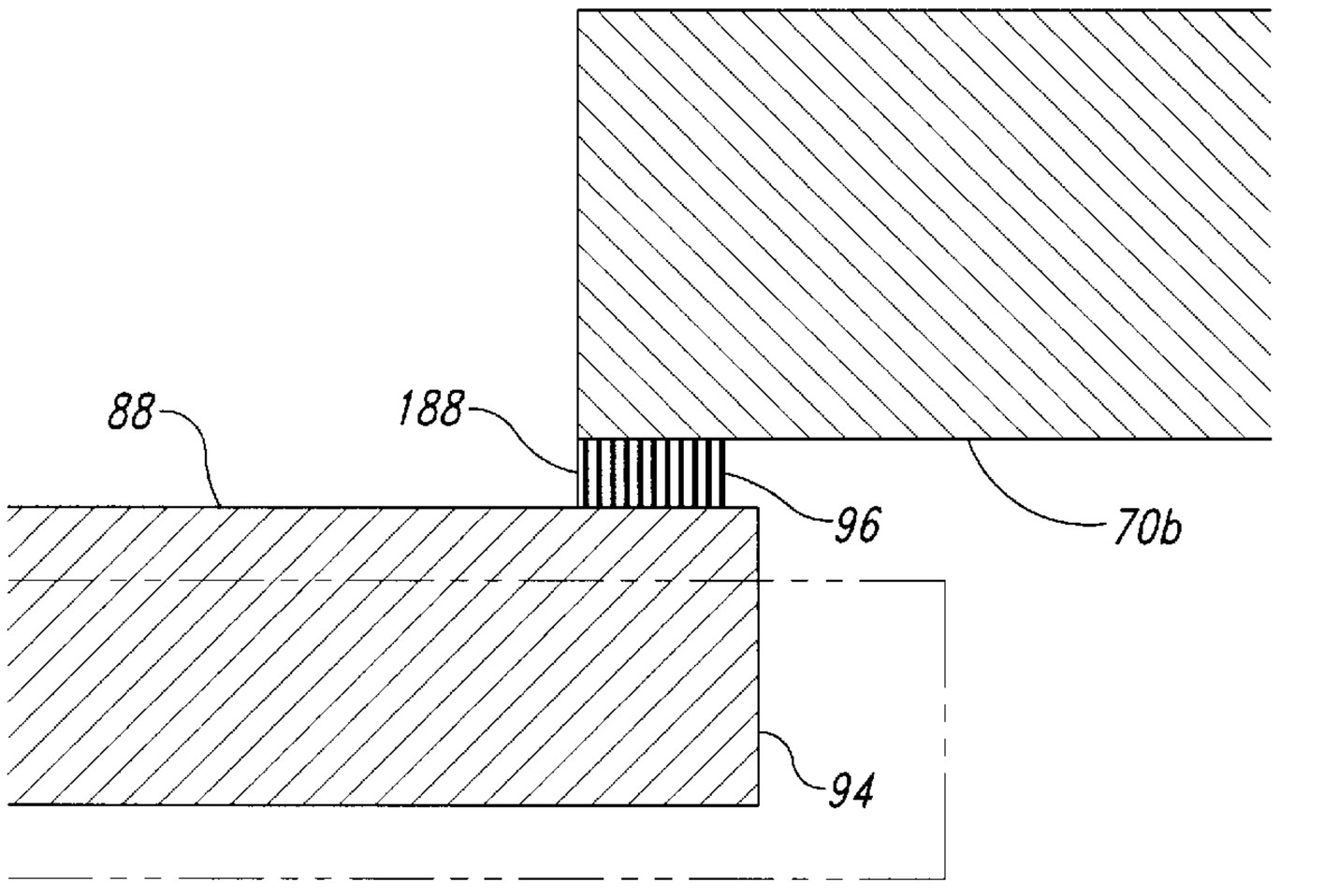

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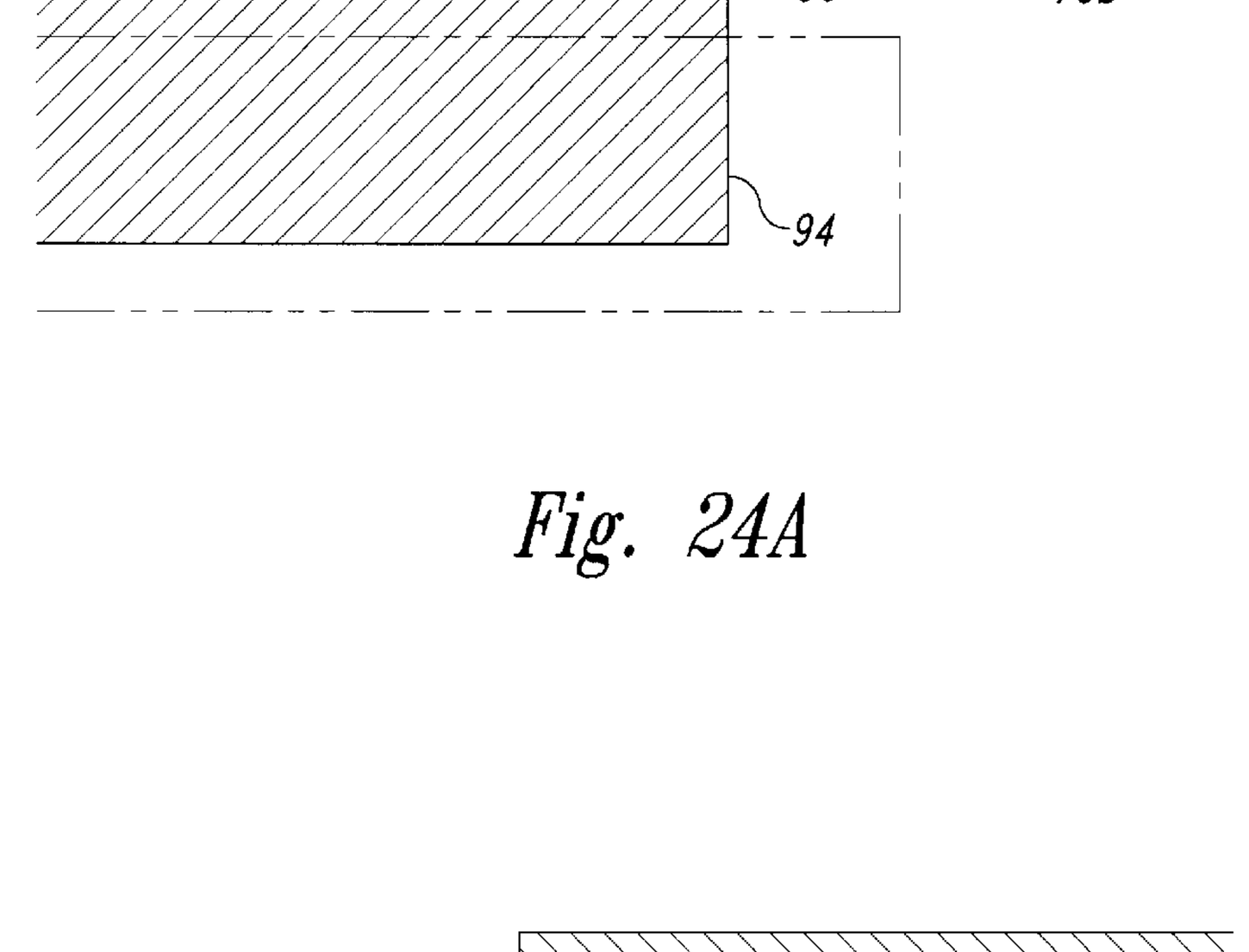

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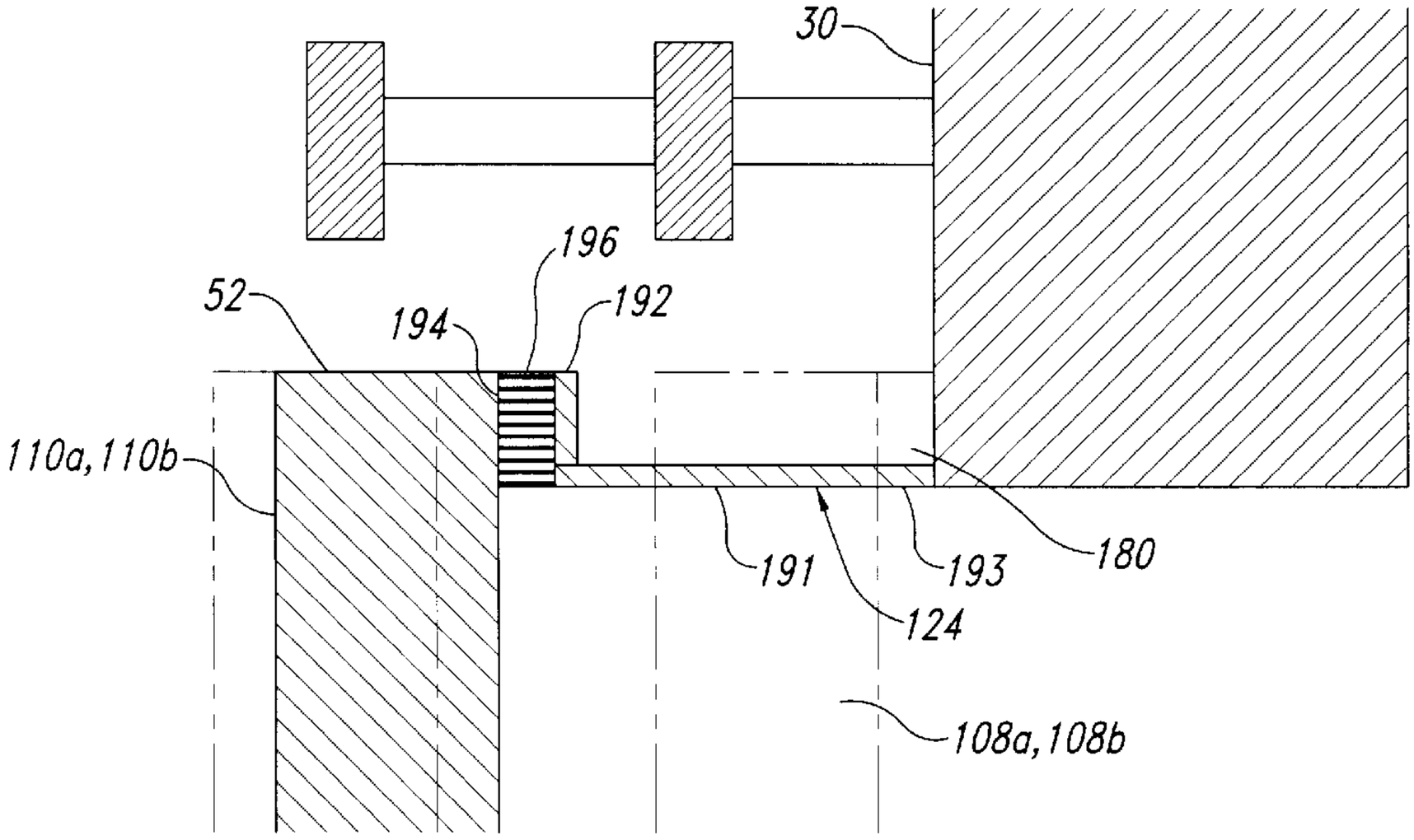

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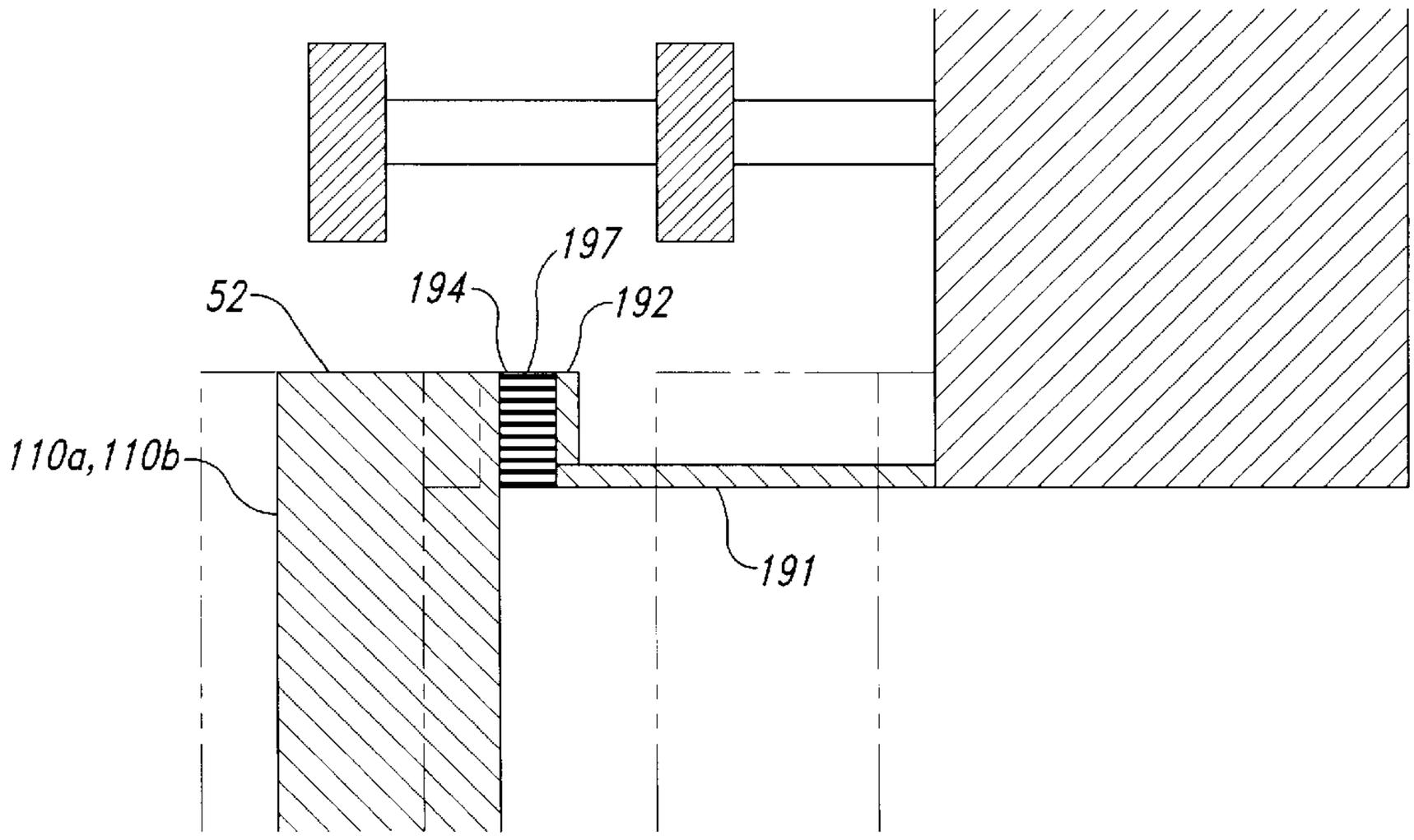

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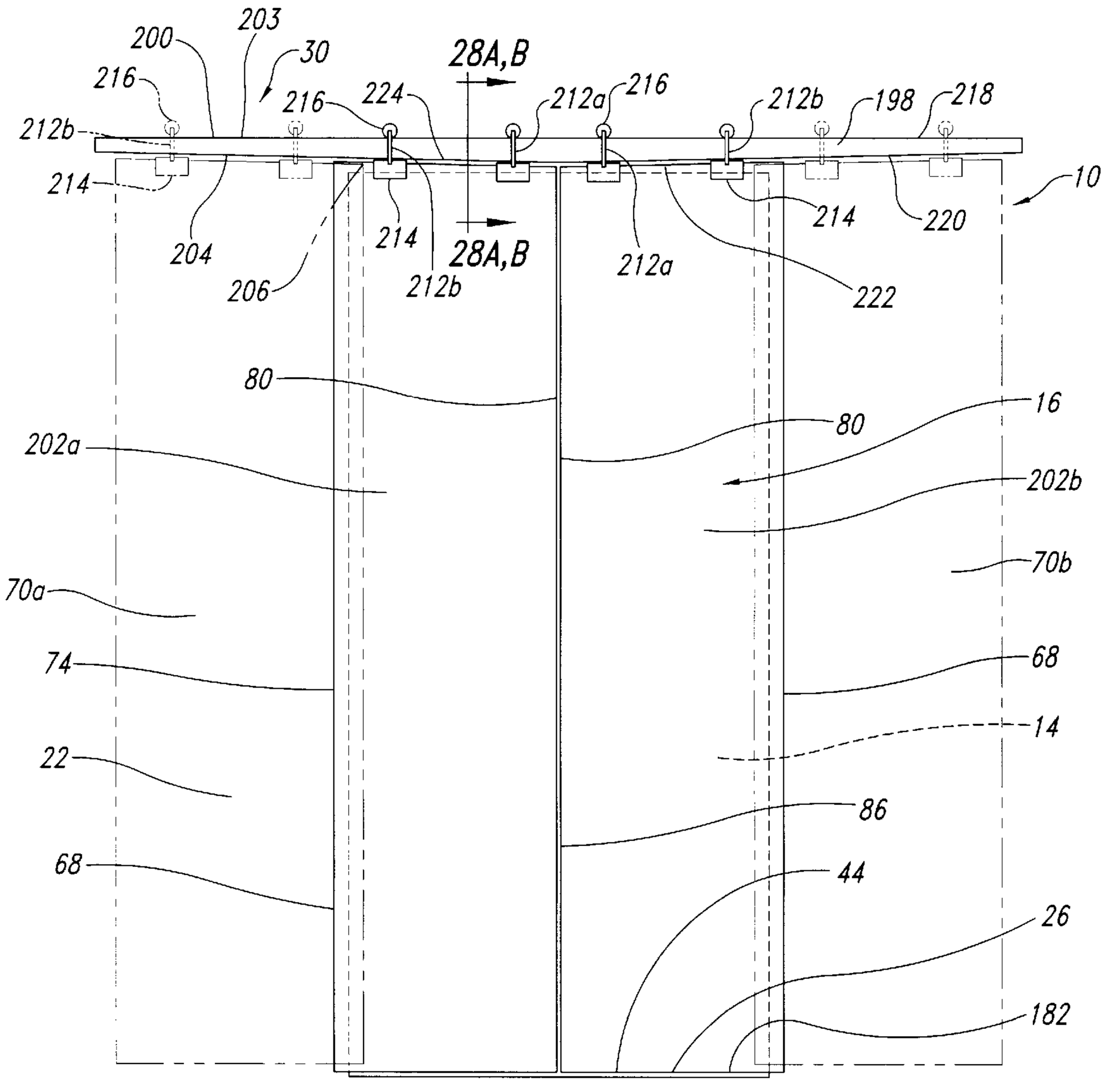
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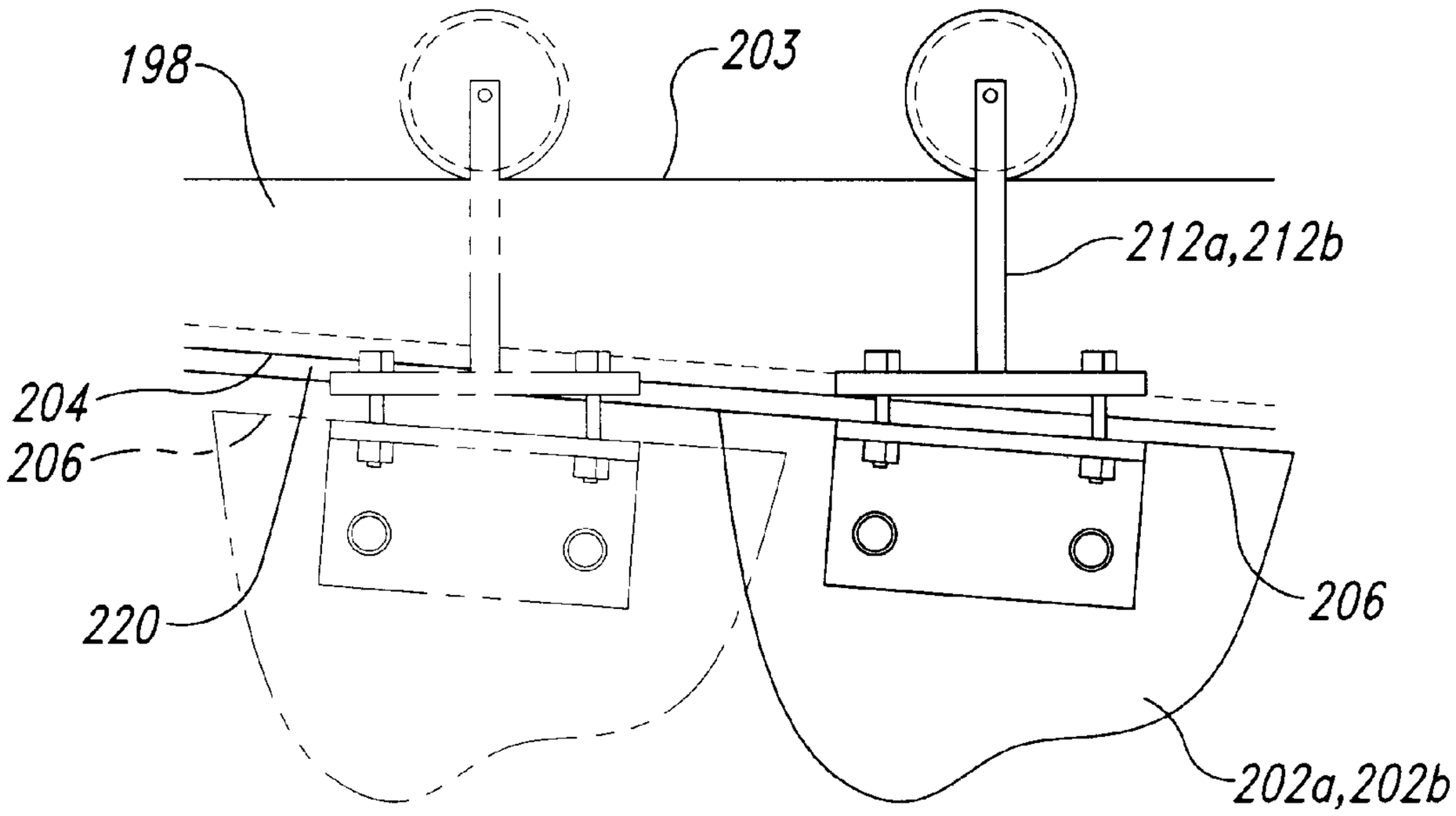
Fig. 26



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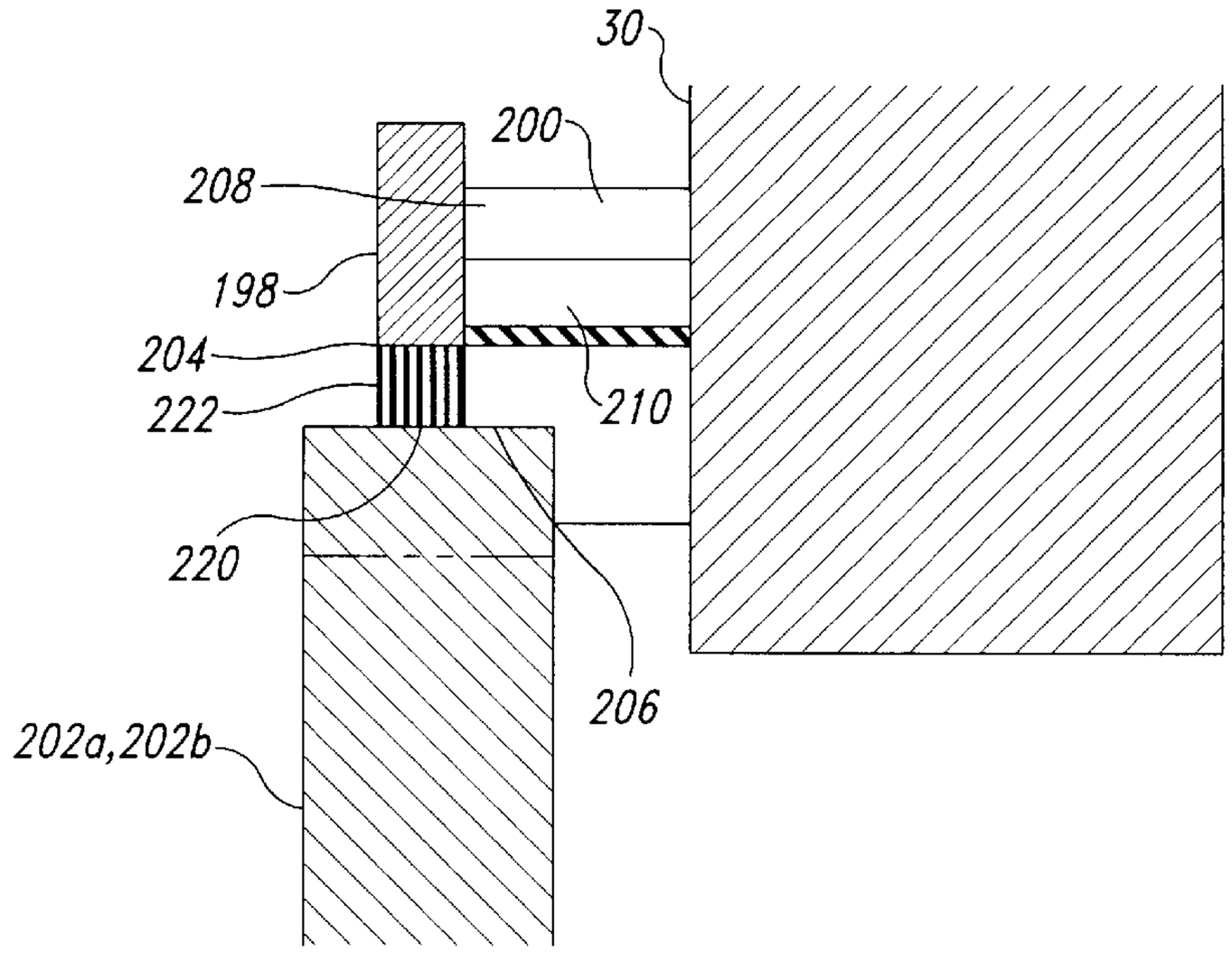

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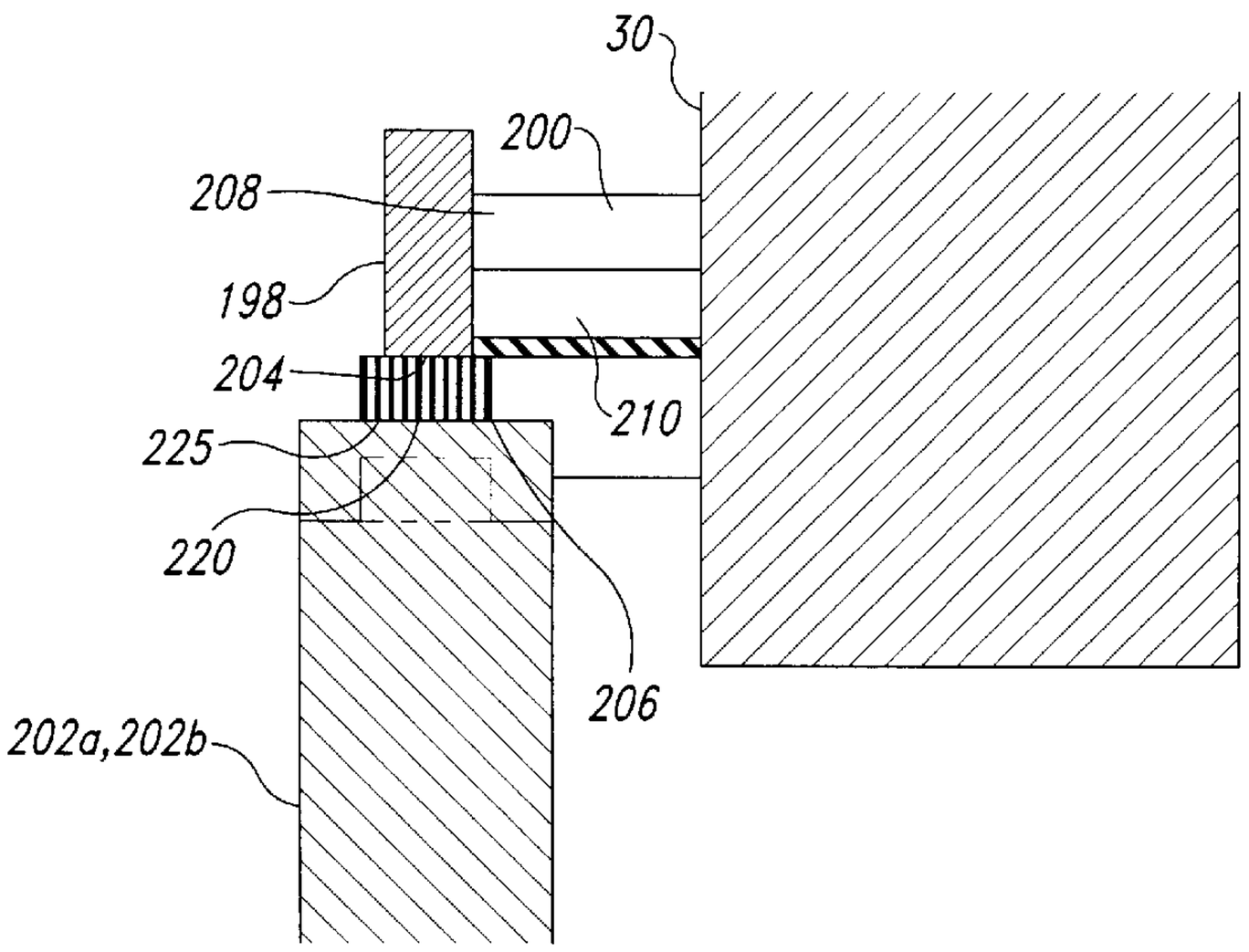

Fig. 28B

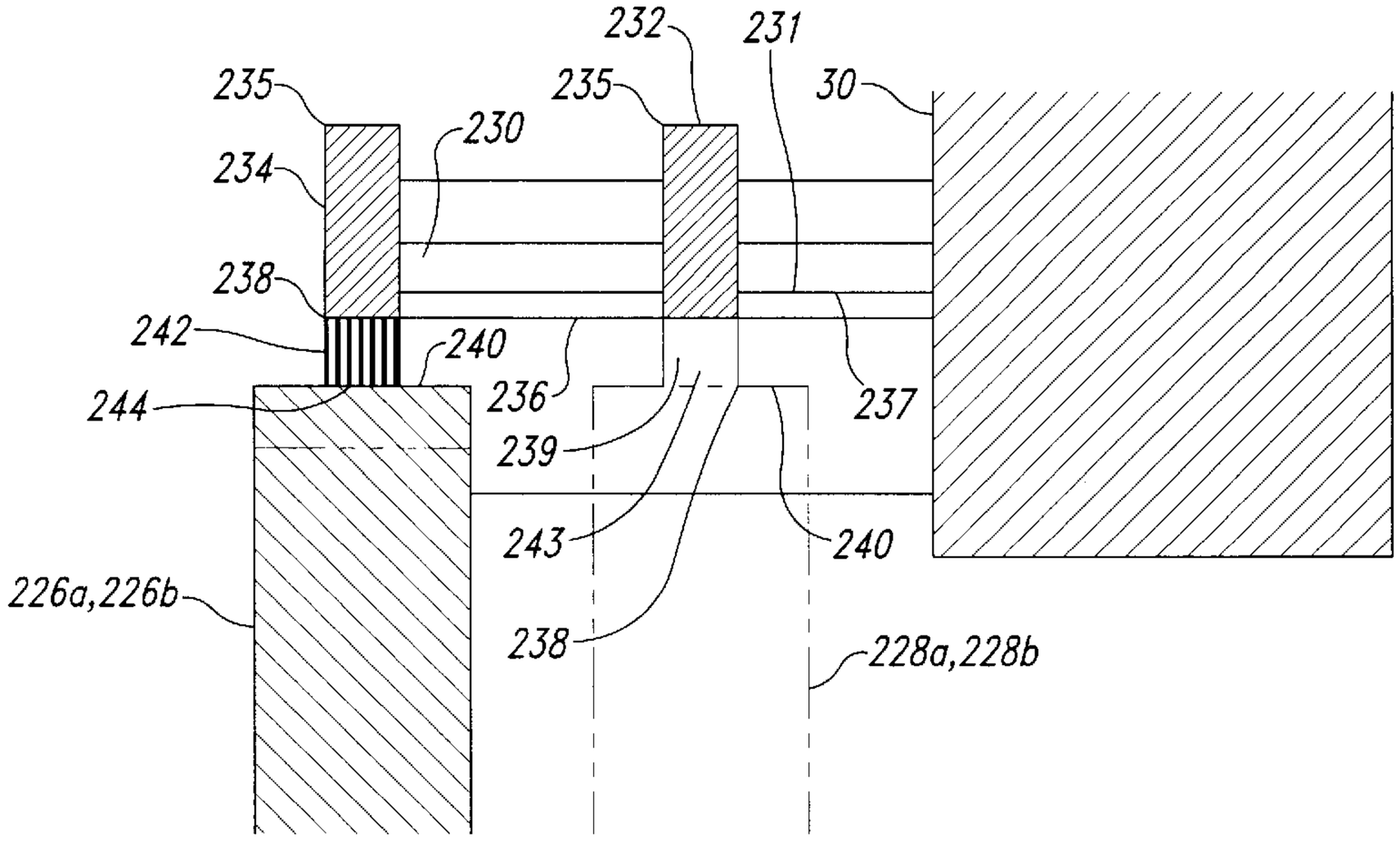

Fig. 29A

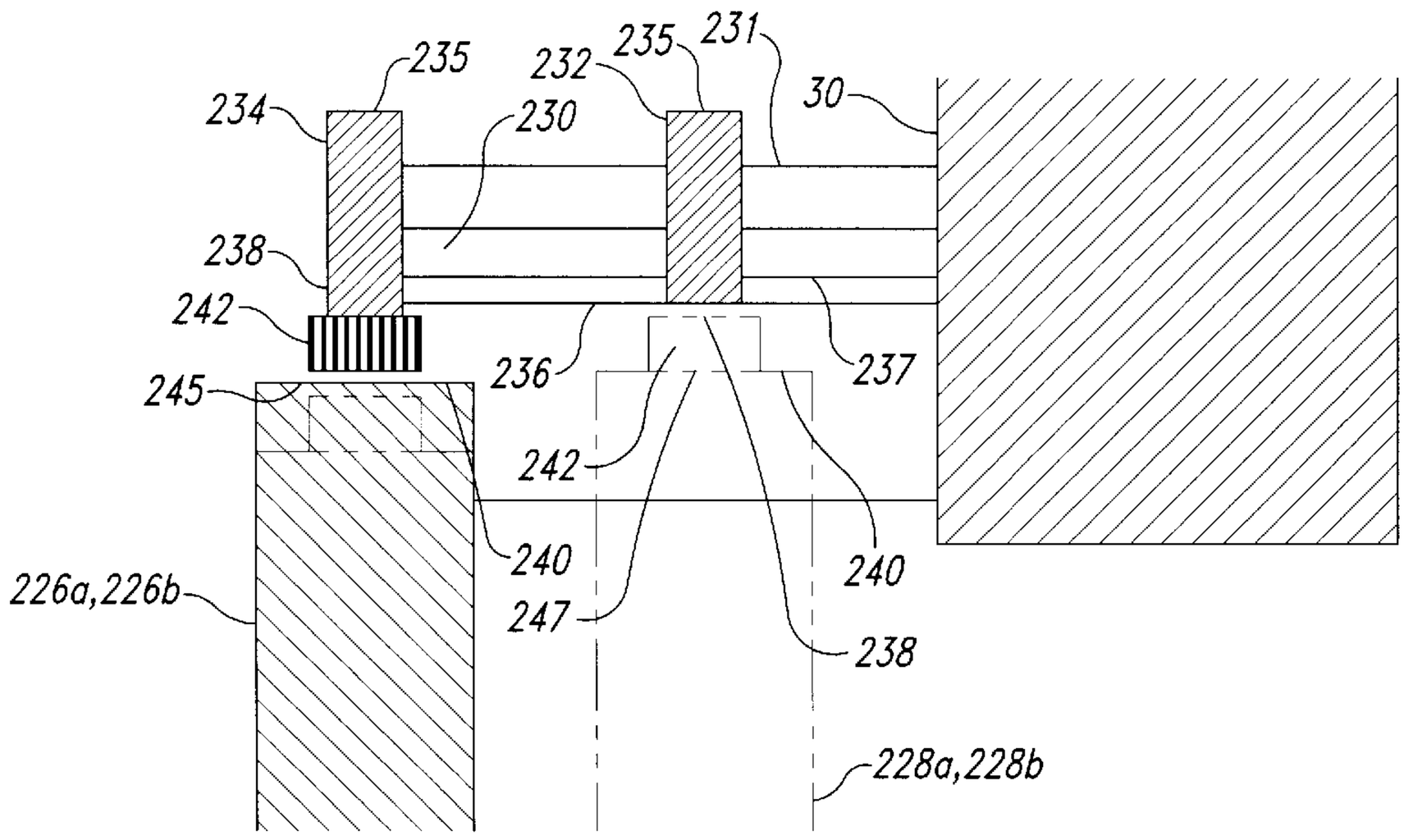

Fig. 29B

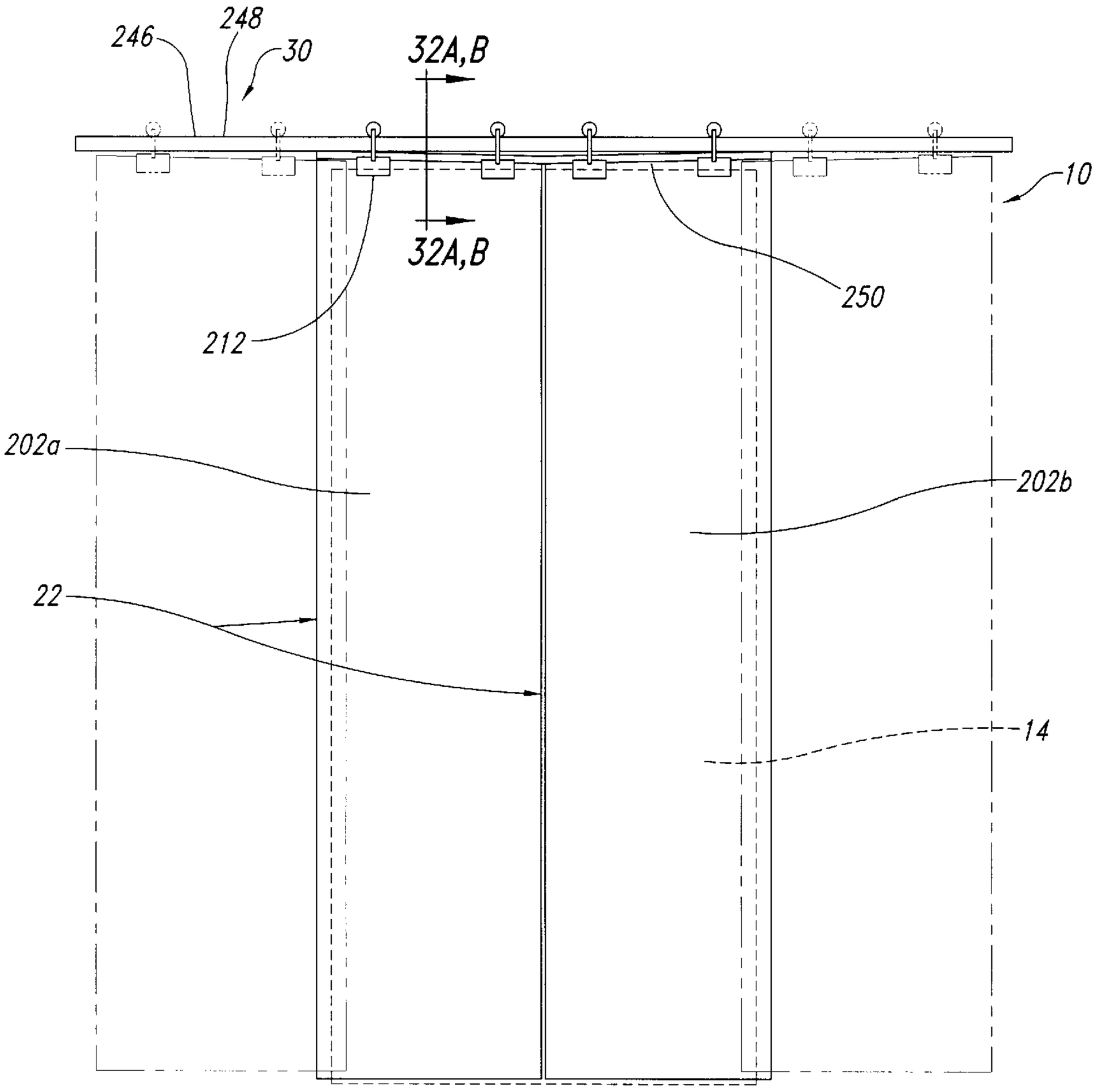

Fig. 30

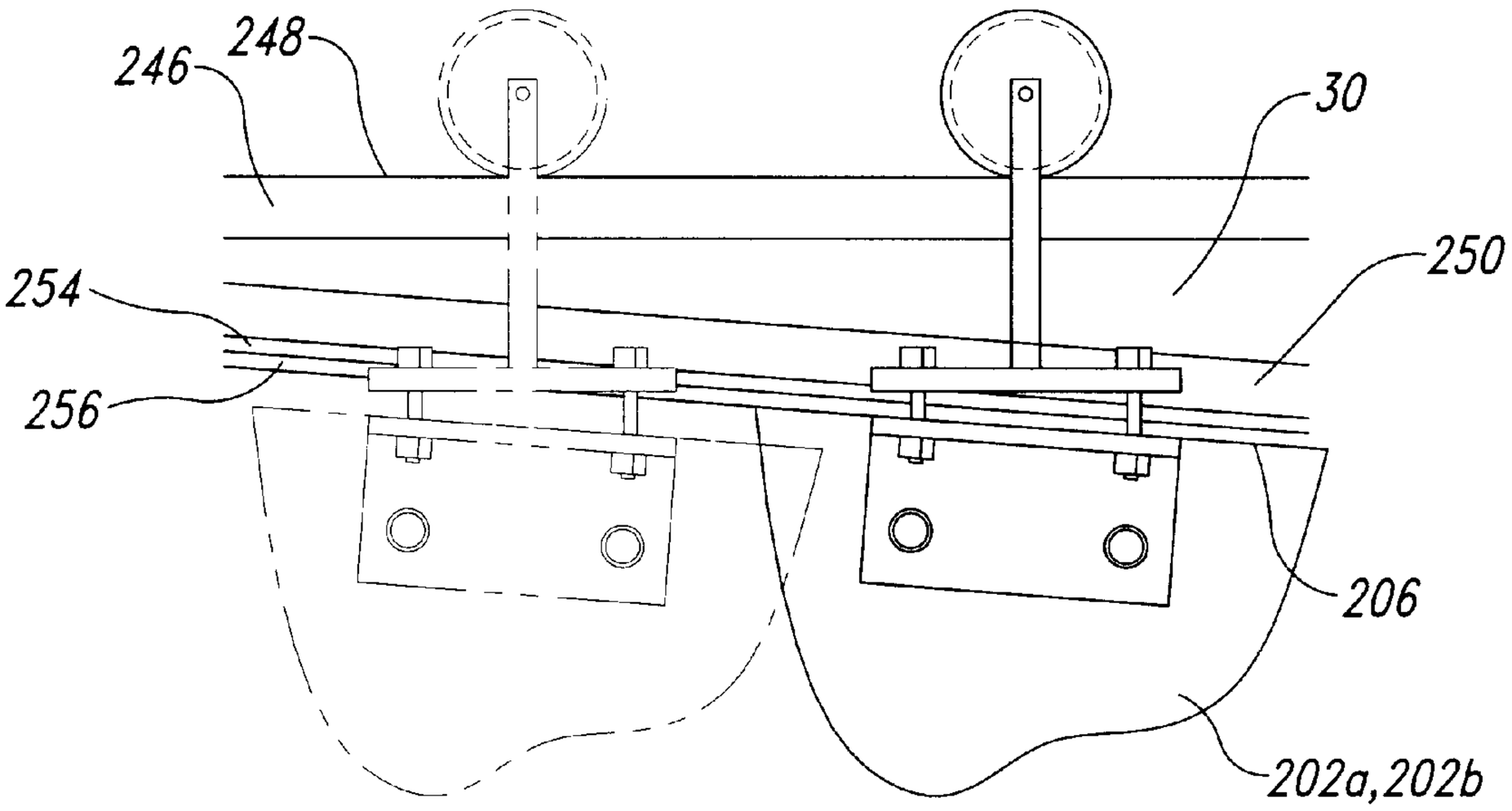

Fig. 31

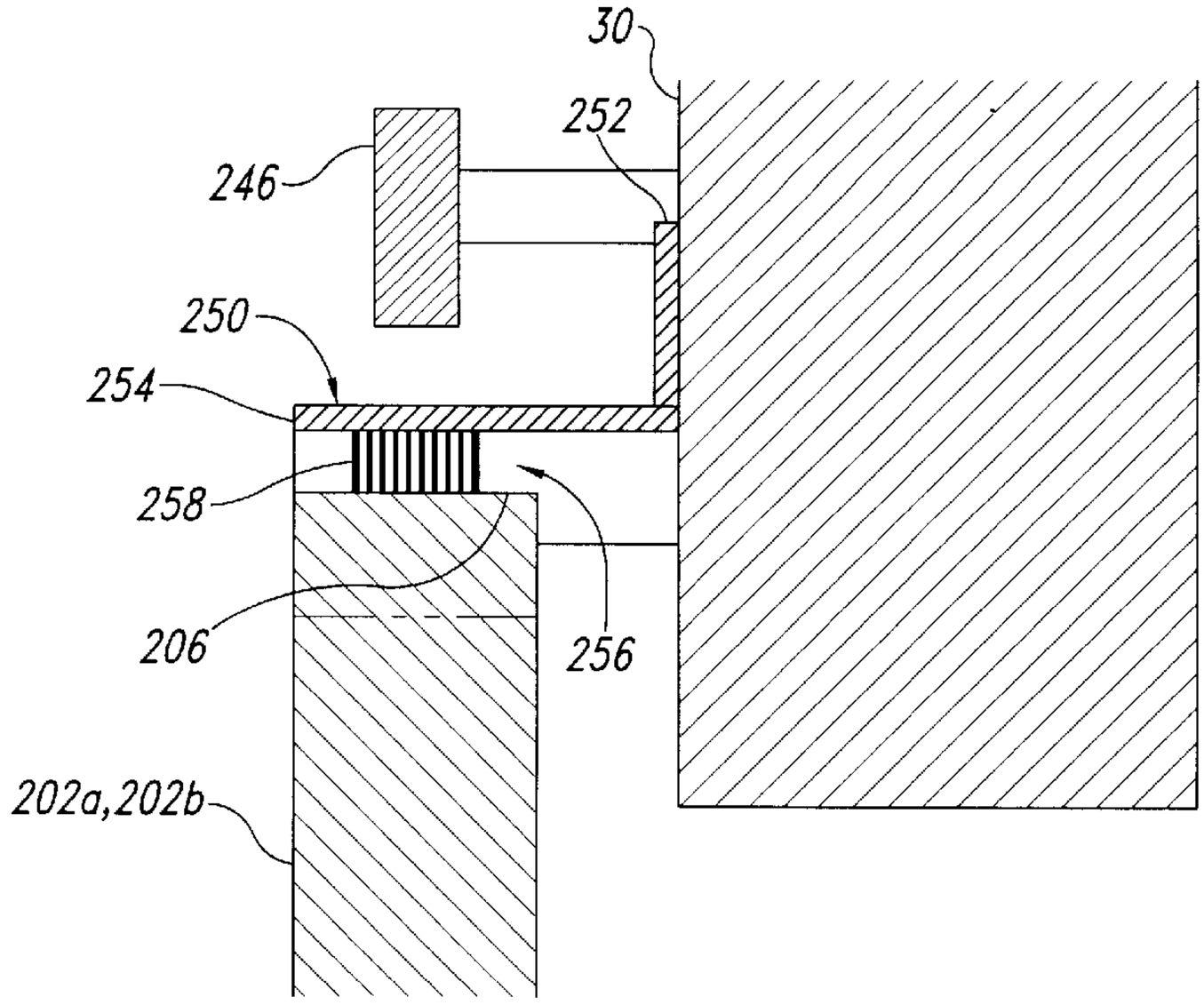

Fig. 32A

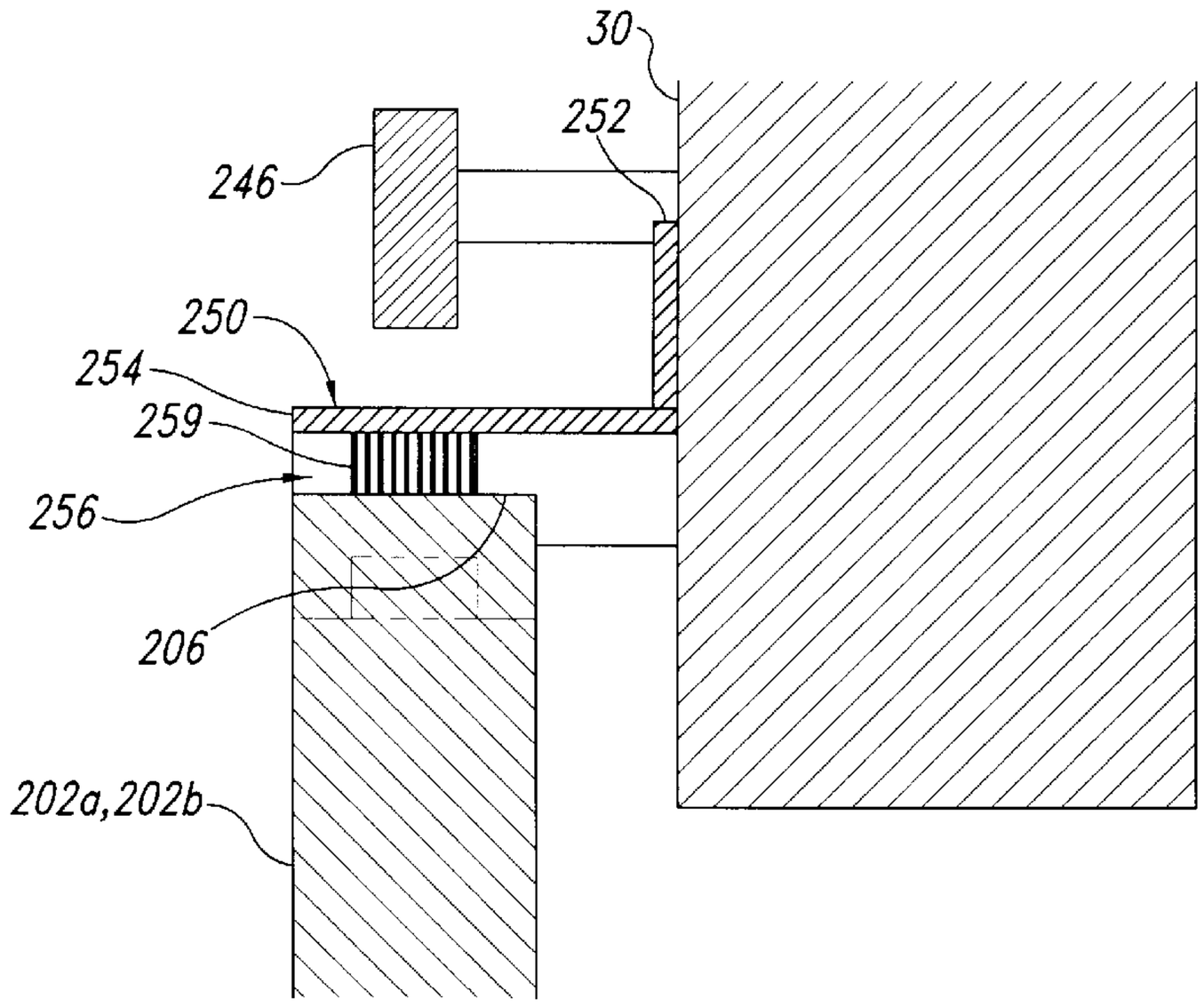

Fig. 32B

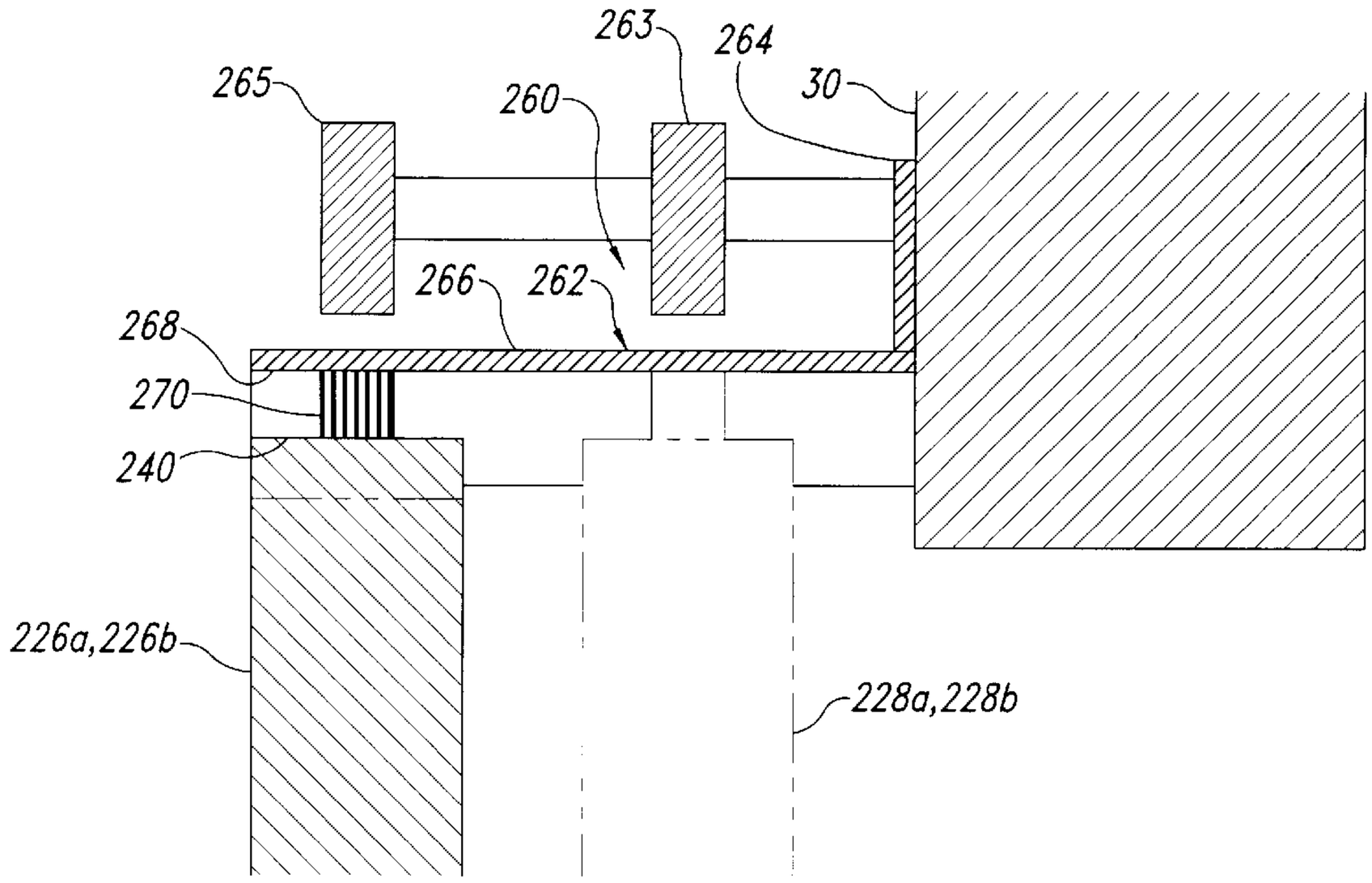

Fig. 33A

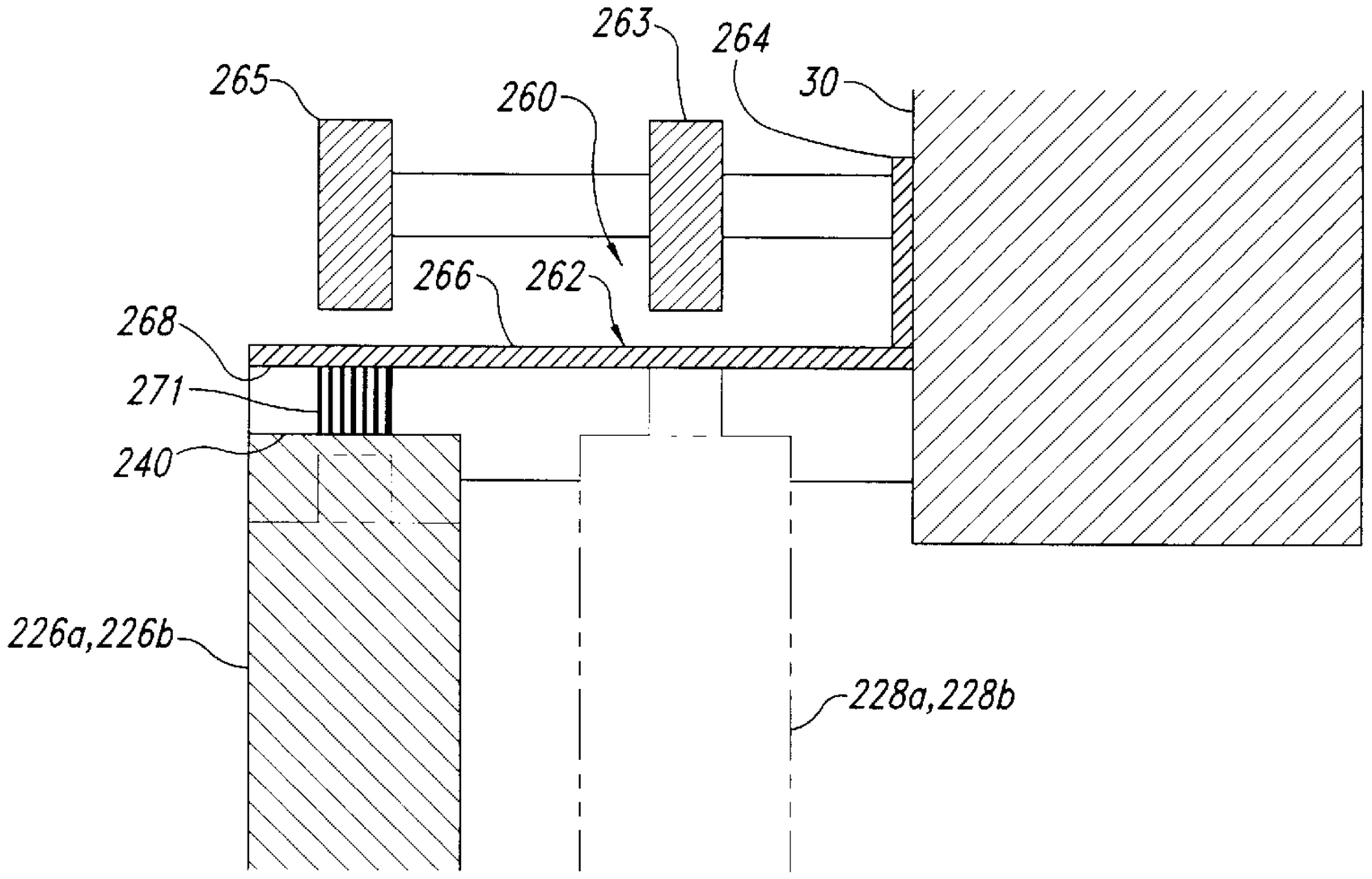

Fig. 33B

HOISTWAY DOOR SEAL STRUCTURE

This application is a continuation of Ser. No. 08/423,958 filed Apr. 18, 1995, abandoned.

TECHNICAL FIELD

The present invention relates to elevator systems and, more particularly, to a hoistway support assembly and a sealing structure mounted between the hoistway door and hoistway entrance.

BACKGROUND OF THE INVENTION

The U.S. Fire Administration and the National Fire Protection Association (NFPA) estimate that 75% of all deaths, injuries and property damage during a building fire is a direct result of smoke. A natural ventilation cycle occurs in the elevator shaft called "stack effect" drawing smoke into the elevator shaft and exhausting it onto upper floor levels. The taller the vertical shaft and the greater the differential between the inside and outside air temperatures, the greater the draft up the shaft. Historically, elevator systems have dealt primarily with providing a safe means of vertical transportation in multi-story buildings and have not addressed the issue of vertical smoke migration via the hoistway shaft.

The World Trade Center building experienced an explosion and fire within a subterranean parking level. The smoke from the fire migrated through the elevator shafts and within minutes following the explosion caused the evacuation of the entire 110 story building complex. The official report of the NFPA noted the inability of the closed hoistway doors to prevent the migration of the smoke as one of the primary sources of the substantial smoke damage experienced throughout the building.

The basic configuration and operation of an elevator system is well known. A multiple level building contains a vertical shaft defined by a top, bottom and vertical structural walls through which an elevator cab travels between levels. Adjacent to each floor level an opening in the structural wall forms a hoistway entrance through which building occupants can safely pass when the elevator cab is adjacent to the hoistway entrance and registered with the lobby floor. An interlock mechanism connects the elevator car door to the hoistway door when the elevator car is positioned adjacent to a floor such that the elevator car door and the hoistway door are moved together to an open or closed position.

The hoistway entrance comprises a hoistway door head frame attached to a headwall and a pair of hoistway door lateral jambs attached to the jambwall. A sill is displaced below the hoistway door at the floor adjacent to the hoistway entrance opening. A head panel extends from the headwall toward the inner hoistway door to fill the space between the headwall and the hoistway door. The head panel provides an aesthetic shield that blocks the workings of the hoistway door from the view of persons entering or exiting the elevator cab.

Conventional hoistway doors include one or more door panels that are movably supported on a horizontal support rail that is connected to the headwall above the hoistway entrance in a generally horizontal orientation. The doors substantially cover the hoistway entrance opening when they are in the closed position. A clearance gap between the hoistway door and the door frame and between the door panels is necessary to allow the door to open and close without excessive resistance due to contact with the door frame. Movement of the hoistway door panels is restricted

to a lateral direction parallel to the hoistway door opening such that the clearance gap is maintained as the hoistway door moves between the open and closed position.

Even though the clearance gap between the elevator hoistway door and the hoistway entrance is limited to 0.375 of an inch by recognized industry standards, large quantities of air freely flow through the clearance gap into and out of the elevator shaft. During a building fire, the stack effect can cause the elevator hoistway to become a smoke stack which quickly distributes smoke and toxic gases throughout the building, thereby jeopardizing human life and property far from the source of the fire.

SUMMARY OF THE INVENTION

The present invention provides a hoistway door seal structure that limits the flow of air through a hoistway opening when the door is in a closed position so as to restrict the passage of smoke in the event of a fire. In a preferred embodiment of the invention, a wall structure has an opening therein defining a hoistway entrance, and a single or multiple of hoistway doors cover the hoistway entrance. Seal structures are positioned between the hoistway doors and the wall structure. The single or multiple hoistway doors are movably supported by an elongated door support member positioned on the wall structure above each of the doors. The door support member is adapted to change the direction of travel of the hoistway door panel relative to the opening and the wall structure as the hoistway door moves between an open position and a closed position.

The door support member further directs the movement of the hoistway door into engagement with the seal structures as the hoistway door is moved to the closed position to cover the hoistway entrance. Accordingly, a barrier is formed as the hoistway door is moved to the closed position, and the barrier blocks smoke and gas migration between the door and the hoistway opening. An interlock catching mechanism, connected to the hoistway door is sized to engage the interlock mechanism connected to an elevator cab door when the hoistway door panel is in the closed position and the elevator cab door is moved from closed to open.

In the preferred embodiment of the invention, each hoistway door is connected to door support members having support trucks and pulley wheels, and the pulley wheels movably engage the door support member. The door support member has lowered portions sized and located to receive the pulley wheels when the door is moved laterally to the closed position, thereby directing the hoistway door in a second direction, such as downwardly toward the sill, upon closing.

In an alternate embodiment, the door support member slopes vertically downward toward the center of the hoistway entrance, with the door support member directing the hoistway door downwardly into engagement with the seal structure as the door panel moves toward the closed position. Thus, the door support member causes the door panel to move laterally and vertically relative to the hoistway opening along the path of travel of each pulley wheel thereby directing the hoistway door panel toward the sill upon closing.

In another alternate embodiment, the door support member has portions that curve inwardly toward the center of the hoistway entrance along the path of travel of each pulley wheel thereby directing the hoistway door panel toward the hoistway entrance upon closing and into sealable engagement with the seal structures.

Accordingly, the instant invention provides an effective barrier to the passage of gas and smoke between the hoistway door and the hoistway entrance, thereby providing an economical solution to the gas/smoke infiltration problem experienced by the elevator industry. Further, the instant invention maintains a high level of safety for passengers traveling in the elevator system by providing a barrier that prevents gas and smoke from entering a hoistway from a floor lobby.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention, along with its many attendant advantages and benefits, will become better understood by reading the detailed description of the preferred embodiment with reference to the following drawings, wherein:

FIG. **1** is a sectional view of a multiple level building, showing an elevator system with an embodiment of the elevator hoistway door seal structure in accordance with the present invention, a hoistway door seal structure being shown with a hoistway entrance on each level adjacent to an elevator lobby.

FIG. **2** is an enlarged side elevation view of the elevator hoistway door seal structure of FIG. **1** with an opposing hoistway door arrangement shown supported from a support member with lowered portions, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **3** is an enlarged fragmentary elevation view of a door support truck and support roller of the hoistway door of FIG. **2** with the door support truck and support roller shown in phantom lines in a raised position with the hoistway door in a position prior to closing and shown in solid lines in a lowered position with the hoistway door in a closed position.

FIG. **4** is an enlarged plan view of the elevator hoistway entrance of FIG. **1** substantially covered with opposing hoistway doors that are movably supported by a support member, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position and movably supported by a support member.

FIG. **5***a* is an enlarged cross-sectional view taken substantially along line **5***a,b*—**5***a,b* of FIG. **2** with the door supports not being shown for clarity, and with a transverse seal structure shown in phantom lines in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **5***b* is an enlarged cross-sectional view taken substantially along line **5***a,b*—**5***a,b* of FIG. **2** with the door supports not being shown for clarity, and with an alternate embodiment of a transverse seal structure shown in phantom lines in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **6***a* is an enlarged cross-sectional view taken substantially along line **6***a,b*—**6***a,b* of FIG. **2** with a sill seal structure shown in phantom lines in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **6***b* is an enlarged cross-sectional view taken substantially along the line **6***a,b*—**6***a,b* of FIG. **2** showing in phantom lines an alternate embodiment of the sill seal structure in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **7***a* is an enlarged cross-sectional view taken substantially along the line **7***a,b*—**7***a,b* of FIG. **2** with a trailing edge seal structure shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a sealed position.

FIG. **7***b* is an enlarged cross-sectional view taken substantially along the line **7***a,b*—**7***a,b* of FIG. **2** showing in phantom lines an alternate embodiment of the trailing edge seal structure in an unsealed position prior to closing and shown in solid lines in a sealed position.

FIG. **8***a* is an enlarged cross-sectional view taken substantially along line **8***a,b*—**8***a,b* of FIG. **2** showing a meeting edge seal structure of the opposing hoistway doors, the meeting edge seal structure being shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **8***b* is an enlarged cross-sectional view taken substantially along line **8***a,b*—**8***a,b* of FIG. **2** showing in phantom lines an alternate embodiment of the meeting edge seal structure in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **9** is an enlarged plan view of a hoistway entrance of FIG. **1** substantially covered with a single hoistway door arrangement that is movably supported by a support member, the hoistway door being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **10***a* is an enlarged cross-sectional view of the leading edge seal structure of the hoistway door of FIG. **9** shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **10***b* is an enlarged cross-sectional view of an alternate embodiment of the leading edge seal structure of the hoistway door of FIG. **9** shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **11***a* is an enlarged plan view of the hoistway entrance of FIG. **1** substantially covered with a pair of opposing hoistway doors that are movably supported by a support member, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **11***b* is a enlarged cross-sectional view taken through the trailing support roller and outer support member of FIG. **11***a*.

FIG. **11***c* is an enlarged cross-sectional view taken through the leading support roller and outer support member of FIG. **11***a*.

FIG. **12***a* is an enlarged sectional view of a lateral edge seal structure between the pair of opposing hoistway doors of FIG. **11***a* shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **12***b* is an enlarged sectional view of an alternate embodiment of a lateral edge seal structure between the pair of opposing hoistway doors of FIG. **11***a* as shown in phantom lines in an unsealed position prior to closing and shown in solid lines in a closed, sealed position.

FIG. **13***a* is an enlarged cross-sectional view taken substantially along line **13***a,b*—**13***a,b* of FIG. **11***a* with the door supports not shown for clarity, and with the transverse edge seal structure shown in phantom lines in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **13***b* is an enlarged cross-sectional view taken substantially alone line **13***a,b*—**13***a,b* of FIG. **11***a* with the door supports not shown for clarity, and with an alternate embodiment of the transverse edge seal structure shown in phantom lines in a raised, unsealed position prior to closing and shown in solid lines in a lowered, sealed position.

FIG. **14** is an enlarged side elevation view of an alternate embodiment of the present invention with opposing hoistway doors supported from a support member sloping vertically downward toward the center of the hoistway entrance, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **15** is an enlarged fragmentary elevation view of a door support truck and a support roller of the hoistway door of FIG. **14** with the door support truck and support roller shown in phantom lines in a raised position with the hoistway door in a position prior to closing and shown in solid lines in a lowered position.

FIG. **16** is an enlarged side elevation view of an alternate embodiment of the present invention with opposing hoistway doors supported from a support member curing horizontally inward toward a headwall, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position with the doors moved inwardly toward the hoistway entrance.

FIG. **17** is an enlarged fragmentary elevation view of a door support truck and a support roller of the hoistway door of FIG. **16** shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in an inward and closed position.

FIG. **18** is an enlarged partial plan view of the support member and the door support truck and support roller of the hoistway door of FIG. **16** shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in an inward and closed position.

FIG. **19** is an enlarged partial plan view of an alternate embodiment of the support member and the door support truck of FIG. **16** shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in an inward and closed position.

FIG. **20***a* is an enlarged cross-sectional view taken substantially along the line **20***a*—**20***a* of FIG. **19** showing the support roller and the support member.

FIG. **20***b* is an enlarged cross-sectional view taken substantially along the line **20***b*—**20***b* of FIG. **19** showing the support roller and a narrowed portion of the support member.

FIG. **21***a* is an enlarged cross-sectional view taken substantially along the line **21***a,b*—**21***a,b* of FIG. **16** with the door supports not shown for clarity, and with a transverse edge seal structure of the outer hoistway door, shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **21***b* is an enlarged cross-sectional view taken substantially along the line **21***a,b*—**21***a,b* of FIG. **16** with the door supports not shown for clarity, and with an alternate embodiment of the transverse edge seal structure shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **22** is and enlarged cross-sectional view taken substantially along line **22**—**22** of FIG. **16** with a sill seal structure shown in a position above the sill.

FIG. **23***a* is an enlarged cross-sectional view taken substantially along the line **23***a,b*—**23***a,b* of FIG. **16** with the trailing edge seal structure shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **23***b* is an enlarged cross-sectional view taken substantially along the line **23***a,b*—**23***a,b* of FIG. **16** with an alternate embodiment of the trailing edge seal structure shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **24***a* is an enlarged cross-sectional view of the leading edge seal structure on a single hoistway door supported on a support member of FIG. **16**, with the hoistway door shown in phantom lines in an outwardly, unsealed position and shown in solid lines in an inward, sealed position.

FIG. **24***b* is an enlarged cross-sectional view of an alternate embodiment of the leading edge seal structure of FIG. **24***a* with the hoistway door shown in phantom lines in an outwardly, unsealed position and shown in solid lines in an inward, sealed position.

FIG. **25***a* is an enlarged cross-sectional view of a pair of adjacent support members of FIG. **16** supporting pairs of opposing hoistway doors similar to FIG. **11***a* with the door supports not shown for clarity, and with the transverse edge seal structure being shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **25***b* is an enlarged cross-sectional view of an alternate embodiment of the transverse edge seal structure of FIG. **25***a*, with the door supports not shown for clarity, and with the hoistway door panel shown in phantom lines in an outwardly, unsealed position prior to closing and shown in solid lines in an inwardly, sealed position.

FIG. **26** is an enlarged side elevation view of an alternate embodiment of the present invention with an opposing hoistway door arrangement shown supported from a support member with a bottom edge sloping vertically downward toward the center of the hoistway entrance, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **27** is an enlarged fragmentary elevation view of a door support truck and a support roller of the hoistway door of FIG. **26** shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **28***a* is an enlarged cross-sectional view taken substantially along the line **28***a,b*—**28***a,b* of FIG. **26** with the door supports not shown for clarity, and with a transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **28***b* is an enlarged cross-sectional view taken substantially along the line **28***a,b*—**28***a,b* of FIG. **26** with the door supports not shown for clarity and with an alternate embodiment of a transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **29***a* is an enlarged cross-sectional view showing a transverse edge seal structure in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **29***b* is an enlarged cross-sectional view of an alternate embodiment of a transverse edge seal structure of FIG. **29***a* with the door supports not shown for clarity and with the transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **30** is an enlarged side elevation of an alternate embodiment of the present invention with opposing hoistway doors shown supported from a support member having

a bottom edge sloping vertically downwardly, the hoistway doors being shown in phantom lines in a position prior to closing and shown in solid lines in a closed position.

FIG. **31** is an enlarged fragmentary elevation view of a door support truck and a support roller of the hoistway door of FIG. **30** with the door support truck and the support roller shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **32***a* is an enlarged cross-sectional view taken substantially along the line **32***a,b*—**32***a,b* of FIG. **30** with the door supports not shown for clarity, and with a transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **32***b* is an enlarged cross-sectional view taken substantially along the line **32***a,b*—**32***a,b* of FIG. **30** with the door supports not shown for clarity, and with an alternate embodiment of a transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **33***a* is an enlarged cross-sectional view of a pair of adjacent supports similar to FIG. **29***a* and in accordance with the alternate embodiment of FIG. **30**, with the door supports not shown for clarity, and with a transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

FIG. **33***b* is an enlarged cross-sectional view of an alternate embodiment of a transverse edge seal structure of FIG. **33***a*, with the door supports not shown for clarity, and with the transverse edge seal structure shown in phantom lines in a position prior to closing and shown in solid lines with the hoistway door in a closed position.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein like reference characters designate identical or corresponding parts, and more particularly to FIG. **1** thereof, there is shown a multiple level building with an elevator hoistway **4** having an upper limit **6** and a lower limit **8**, with a wall structure **10** extending therebetween. A hoistway opening **12** in the wall structure **10** occurs at each level, defining a hoistway entrance **14** which is closable by a movable hoistway door assembly **16**. When an elevator cab **18** is adjacent to an elevator lobby floor **20** and directly adjacent to the hoistway entrance **14**, the hoistway door assembly **16** is moved by a conventional interlock system to an open position to allow passengers to pass through the hoistway entrance, and when the elevator cab is not adjacent to the elevator lobby floor, the hoistway door assembly remains in a closed position.

The hoistway door assembly **16** is movably supported by a hoistway door seal structure **22** in accordance with the present invention. The hoistway door seal structure **22** of the preferred embodiment is adjacent to each hoistway entrance **14** and is positioned to provide seals between the hoistway door assembly **16** and the wall structure **10** around the hoistway opening **12**.

The hoistway door seal structure **22** engageably seals the gap between the hoistway door assembly **16** and the wall structure **10** when the hoistway door is moved from an open position toward a closed position to limit the flow of air through the hoistway opening **12**. Accordingly, the hoistway door seal structure **22** restricts the passage of gas and smoke between the hoistway door assembly **16** and the wall structure **10** in the event of a fire. The hoistway door seal structure **22** includes seals, discussed in greater detail below, that are constructed of shaped, temperature resistive material or other material such as light gauge metal, silicone, metallic brushes etc. that can be slightly compressed when the hoistway door assembly **12** is moved into engagement therewith to create an effective seal between the hoistway door assembly and the wall structure **10**. Although the embodiments described herein are described in terms of the seals around the hoistway door assembly **12** blocking the flow of smoke and as in the event of a fire, the seals are also effective in blocking the flow of air or the like between the hoistway door assembly and the wall structure **12** during operation of the hoistway, during maintenance thereof, or the like.

As best seen in FIG. **2**, the hoistway entrance **14** in the wall structure **10** is a rectangular opening defined by a left lateral jamb **24***a*, a right lateral jamb **24***b*, a bottom sill **26**, and a head **28** opposite the sill. The hoistway door seal structure **22** adjacent to the hoistway entrance **14** includes the hoistway door assembly **16** that moves laterally relative to the hoistway entrance **14** between an open position, shown in phantom lines, permitting access to the elevator hoistway, and a closed position, shown in solid lines. In the closed position, the hoistway door assembly **16** substantially covers the hoistway entrance **14**.

In the illustrated embodiment, the hoistway door assembly **16** includes a pair of opposing doors **16***a* and **16***b* that are laterally movable relative to the hoistway entrance **14**. The pair of opposing doors **16***a* and **16***b* are interconnected in a conventional manner, such that the lateral movement of each of the hoistway doors between the open and closed positions is synchronized. Although the illustrated embodiment includes a pair of opposing doors **16***a* and **16***b*, the door assembly **16** can have other configurations, such as a single door configuration, or a configuration having a multiple pair of opposing doors, as discussed below.

The pair of hoistway doors **16***a* and **16***b* are movably supported outwardly adjacent to the hoistway entrance **14** by an elongated door support member **29** that is secured to a headwall **30** above the head **28**. The door support member **29** is securely mounted in a generally horizontal position above the hoistway entrance **14**. Each of the hoistway doors **16***a* and **16***b* is movably attached to the door support member **29** by a pair of door supports **32** that move laterally along the door support member when the hoistway doors move between the open and closed positions. Each door support **32** includes a door support truck **34** secured to the top of the respective hoistway door **16***a* and **16***b*, and a support roller **36** rotatably attached to the top portion of the door support truck **34**. The support roller **36** movably engages a roller support surface **38** on the top of the door support member **29** so as to permit the lateral movement of the hoistway doors **16***a* and **16***b* between an open and closed position.

The hoistway door seal structure **22** also includes a plurality of seals **23** positioned between the hoistway doors **16***a* and **16***b* and the wall structure **10** around the hoistway entrance **14**. The seals **23** fill and seal spaces between the hoistway doors and the wall structure when the hoistway doors are in the closed position. Accordingly, the seals **23** restrict the passage of gas and smoke through the spaces in the event of a fire. The formation of these seals **23** is facilitated by the door support member **29**, which is constructed to move the hoistway doors **16***a* and **16***b* laterally from the open position shown in phantom lines toward the closed positions shown in solid lines, and as the hoistway doors approach the closed position, the door support mem-

ber simultaneously moves the hoistway doors in a second direction, such as vertically downward into sealable engagement with the seals. A conventional interlock mechanism is coupled to the hoistway doors so as to engage a conventional elevator cab door of the elevator cab **18**, FIG. **1**, thereby simultaneously moving the hoistway doors and the elevator cab door to the open or closed positions to allow ingress or egress from the elevator cab.

As best seen in FIG. **3**, the door support member **29** is a substantially horizontal rail with the uppermost edge of the rail forming the roller support surface **38**. The door support member **29** includes a plurality of horizontal upper portions **40** and a plurality of lowered portions **42** adjacent to at least one of the upper portions. Each of the lower portions **42** is positioned with the lowered portion providing a recessed area within the support member **29** that is shaped to receive one of the support rollers **36** when the hoistway doors **16***a* and **16***b* move to the closed position, as shown in solid lines in FIG. **2**. Accordingly, the support rollers **36** travel along the horizontal upper portions **40** of the door support member **29** when the hoistway doors are moving to or from the closed position such that the hoistway doors **16***a* and **16***b* are in a raised position, as shown in phantom lines in FIG. **2**. In the raised position as best seen in FIG. **2**, a bottom edge **44** of each hoistway door **16***a* and **16***b* is positioned above the sill **26** with a sill space **46** therebetween.

As the hoistway doors **16***a* and **16***b* move laterally from the open and raised positions to the closed and lowered positions, the support rollers **36** move from the horizontal upper portions **40** downwardly into their respective lowered portions **42**, thereby causing the hoistway doors to simultaneously move downwardly to a lowered position. In the lowered position the bottom edge **44** of each hoistway door **16***a* and **16***b* is immediately adjacent to the sill **26**. As discussed in greater detail below, when the door panels **16***a* and **16***b* move to the closed and lowered position, seals are formed around the hoistway entrance **14** so as to block the flow of smoke and gas between the doors **16***a* and **16***b* and the wall structure **10**.

As best seen in FIG. **3**, the lowered portion **42** in the door support **29** has a sloped portion **48** that slopes downwardly from the adjacent horizontal upper portion **40**, and the sloped portion connects to a curved seat portion **50**. Each seat portion **50** has a radius that is slightly greater than the radius of the support roller **36**, such that the respective support roller will travel downwardly along the sloped portion **48** and sit within the seat portion when the respective hoistway door is in the closed position. Accordingly, the seat portions **50** facilitate in retaining the hoistway doors **16***a* and **16***b* in the closed position. The sloped portions **48** provides a gradual transition for the support rollers **36** as the hoistway doors **16***a* and **16***b* move between the closed and lowered position and the open and raised position.

Accordingly, the support rollers **36** travel along the horizontal upper portions **40** of the door support member **29** as the left and right hoistway doors **16***a* and **16***b*, FIG. **2**, are moved laterally from the open position toward the closed position. When the hoistway doors **16***a* and **16***b* approach the closed position, each of the support rollers **36** move downwardly into a respective one of the lowered portions **42** and the hoistway doors are moved vertically downward toward the sill **26**. When the left and right hoistway doors **16***a* and **16***b* move away from the closed position, the support rollers **36** move from the lowered portions **42** upwardly along the sloped portions **48** toward the horizontal upper section **40**. Accordingly, the hoistway doors **16***a* and **16***b* are lifted from the lowered position to the raised position. Thereafter, the hoistway doors **16***a* and **16***b* move horizontally to the fully open position, and the necessary force exerted on the hoistway doors is required to overcome only the minimal amount of frictional resistance between the support rollers **36** and the roller support surface **38**.

The hoistway doors **16***a* and **16***b* move together in a synchronized manner between an open and raised position, shown in phantom lines in FIG. **4** that permits access to the elevator cab **18**, and a closed and lowered position, shown in solid lines, where the hoistway doors substantially cover the hoistway entrance **14**.

As best seen in FIG. **4**, the door support member **29** is connected to the headwall **30** with brackets **58**, and the roller support surface **38** is positioned outwardly away from the headwall. Each of the hoistway doors **16***a* and **16***b* has a transverse edge portion **52** along the top of the door that is outwardly adjacent to the headwall **30**, thereby providing a transverse space **54** between the transverse edge portion and the headwall. An elongated transverse seal structure **56** is positioned between the transverse edge portion **52** and the headwall **30** above the hoistway entrance **14**. When the hoistway doors **16***a* and **16***b* are in the closed and lowered position, as shown in solid lines, the transverse seal structure **56** substantially fills the transverse space **54**, for example, to block the passage of gas or smoke therethrough in the event of a fire or the like.

As best seen in FIG. **5***a*, the transverse seal structure **56** has an elongated transverse extension **60** and an elongated transverse seal **62**, wherein the elongated transverse extension is securely fastened to the transverse edge **52** of each hoistway door **16***a* and **16***b* such that the transverse extension **60** extends along the transverse edge portion of the door. The transverse seal **62** is secured to the headwall **30** near the head **28** below the transverse extension **60** such that the transverse seal **62** extends along the length of the hoistway doors **16***a* and **16***b* when in the closed and lowered position. The transverse extension **60** extends away from its respective hoistway door **16***a* or **16***b* into the transverse space **54** toward the headwall **30**, and provides a horizontal blade-like structure along the top edge of the hoistway doors. The transverse seal **62** projects outwardly away from the headwall **30** toward the hoistway doors **16***a* and **16***b* in such a position wherein the transverse extension **60** is in an overlapping relationship with the transverse seal.

The transverse extension **60** is above and out of engagement with the transverse seal **62** when the respective hoistway doors **16***a* and **16***b* are in the open and raised position, shown in phantom lines, thereby avoiding frictional resistance between the transverse extension and the transverse seal as the door is moving between the open and closed positions. When the hoistway doors **16***a* and **16***b* are moved to the closed and lowered position, shown in solid lines, the transverse extension **60** moves downwardly into sealable engagement with the transverse seal **62** so as to seal the transverse space **54**, thereby blocking the flow of gas or smoke through the transverse space in the event a building fire or the like.

In the preferred embodiment, the transverse extension **60** is a substantially rigid, blade-like member. The elongated transverse seal **62** is a shaped, resilient temperature resistive structure that is slightly compressed by the transverse extension **60** when the hoistway doors **16***a* and **16***b* are moved to the closed and lowered position. The shaped, resilient temperature resistive structure is adapted to maintain its structural integrity in elevated temperatures, such as the temperature experienced in a building fire. Accordingly, a seal is

maintained between the hoistway doors **16***a* and **16***b* and the headwall **30** during a fire or the like.

As best seen in FIG. **5***b*, an alternate embodiment of the transverse seal structure **56** has an elongated transverse extension **61** securely mounted to the head **28** along the head's length. The transverse extension **61** extends away from the headwall **30** toward the hoistway doors **16***a* and **16***b* and into the transverse space **54**. An elongated transverse seal **63** is securely attached along the length of the top of each of the hoistway doors **16***a* and **16***b* adjacent to the transverse edge portion **52**, and the transverse seal extends away from the hoistway door toward the headwall **30**. The transverse seals **63** are positioned above the transverse extension **61** in an overlapping relationship. Accordingly, when the hoistway doors **16***a* and **16***b* are moved from the open and raised position, shown in phantom lines, to the closed and lowered position, shown in solid lines, the transverse seal **63** moves downwardly into sealable engagement with the transverse extension **61** and seals the transverse space **54**.

Referring to FIG. **2**, the bottom edge **44** of each hoistway door **16***a* and **16***b* is positioned above the sill **26** at a selected distance that defines a sill space **46** between the hoistway doors and the sill. As best seen in FIG. **6***a*, a bottom door seal structure **64** of the seals **23** is securely attached to the bottom edge **44** of each hoistway door **16***a* and **16***b*. The bottom door seal structure **64** includes elongated inner and outer bottom door seals **66***a* and **66***b* spaced apart on the bottom edge **44** of each hoistway door **16***a* and **16***b* such that the bottom door seals extend the length of the respective door.

The bottom door seals **66***a* and **66***b* extend downwardly toward the sill **26**. When the hoistway doors **16***a* and **16***b* are in the open and raised position, shown in phantom lines, the bottom door seals **66***a* and **66***b* are above and out of engagement with the sill **26** so as to minimize frictional resistance to lateral motion of the hoistway doors. When the hoistway doors **16***a* and **16***b* are moved to the closed and lowered position, as discussed above, the bottom door seals **66***a* and **66***b* are lowered into sealable engagement with the sill **26** and seal the sill space **46**. In the preferred embodiment, the bottom door seals **66***a* and **66***b* are a shaped, resilient temperature resistive material that are slightly compressed against the sill **26** when the hoistway doors **16***a* and **16***b* are moved to the closed and lowered position.

An alternate embodiment of the bottom door seal structure **64** is illustrated in FIG. **6***b* wherein a single bottom door seal **67** is securely attached to the bottom edge **44** of each of the hoistway doors **16***a* and **16***b*. The single bottom door seal **67** extends along the bottom edge **44** of the respective hoistway door and extends downwardly from the bottom edge **44** of the respective door. The bottom door seal **67** sealably engages the sill **26** when the hoistway doors **16***a* and **16***b* are moved to the closed and lowered position, shown in solid lines, thereby sealing the sill space **46**.

As best seen in FIGS. **2** and **4**, each of the hoistway doors **16***a* and **16***b* has a trailing edge portion **68** that is positioned outwardly adjacent to a respective left and right jambwall **70***a* and **70***b*. As best seen in FIG. **4**, each of the hoistway doors **16***a* and **16***b* is positioned such that a trailing edge lateral space **72** is located between the trailing edge portion **68** of the respective hoistway door **16***a* and **16***b* and the respective left and right jambwall **70***a* and **70***b*. A trailing edge seal structure **74** of the seals **23** is positioned between the trailing edge portion **68** of each hoistway door **16***a* and **16***b* and the jambwalls **70***a* and **70***b* to seal the trailing edge lateral spaces **72** when the hoistway doors are in the closed position.

As best seen in FIG. **7***a*, the trailing edge seal structure **74** includes an elongated lateral extension **76** secured to the trailing edge portion **68** of each of the hoistway doors **16***a* and **16***b*. The lateral extension **76** extends along the trailing edge portion **68** of the respective door **16***a* and **16***b*. The lateral extension **76** also extends toward the respective jambwall **70***a* and **70***b* and into the trailing edge lateral spaces **72**. An elongated trailing edge lateral seal **78** is connected to each of the left and right jambwalls **70***a* and **70***b* near the lateral jamb **24**. The trailing edge lateral seal **78** extends into the trailing edge space **72** in an overlapping relationship with the associated lateral extension **76**.

When the hoistway doors **16***a* and **16***b* are moved to and from the open position, the lateral extension **76** does not engage the respective jambwalls **70***a* and **70***b*, thereby minimizing frictional resistance to lateral movement of the hoistway doors. When the hoistway doors **16***a* and **16***b* are moved to the closed position, each of the lateral extensions **76** is pressed against and sealably engages the trailing edge lateral seal **78** to seal the trailing edge space **72** along the height of the hoistway doors. In the preferred embodiment, each of the elongated lateral extensions **76** is a substantially rigid, blade-like member, and each of the trailing edge lateral seals **78** is a shaped, resilient temperature resistive material that is slightly compressed by the lateral extension when the hoistway doors **16***a* and **16***b* are moved to the closed position.

In an alternate embodiment, illustrated in FIG. **7***b*, the trailing edge seal structure **74** includes an elongated lateral extension **77** that is secured to each of the left and right jambwalls **70***a* and **70***b* near the jamb **24**. The lateral extensions **77** project outwardly from the jambs toward the respective hoistway doors **16***a* and **16***b*. Each of the lateral extensions **77** is an L-shaped bracket with one leg parallel to the respective jambwall **70***a* and **70***b*, and a second leg perpendicular to the jambwall and extending into the trailing edge space **72**. An elongated trailing edge lateral seal **79** is securely attached to the hoistway doors **16***a* and **16***b* adjacent to the trailing edge portion **68**. The trailing edge lateral seal extends into the trailing edge space **72** toward the jambwalls **70***a* and **70***b*. The trailing edge lateral seal **79** is positioned in an overlapping relationship with the second leg of the associated lateral extension **77**.

When the hoistway doors **16***a* and **16***b* are moved to and from the open position, the trailing edge lateral seal **79** is not in engagement with the lateral extension **77** so as to minimize resistance to lateral movement of the hoistway doors. When the hoistway doors **16***a* and **16***b* are moved to the closed position, the trailing edge lateral seal **79** presses against the second leg of the lateral extension **77** and seals the trailing edge space **72**, for example, to limit smoke and gas flow therethrough in the event of a fire or the like. Although the lateral extension **77** of the alternate embodiment is illustrated as an L-shaped member, the lateral extension could be a blade structure or other structure against which the trailing edge lateral seal **79** can sealably press to seal the trailing edge space **72**.

As best seen in FIG. **2**, each of the hoistway doors **16***a* and **16***b* has a meeting edge **80** that extends between the transverse edge **52** and the bottom edge **44** of the respective hoistway door. As best seen in FIG. **4**, the hoistway doors **16***a* and **16***b* are configured such that a meeting edge space **82** is provided between the meeting edges **80** of the doors when the hoistway doors **16***a* and **16***b* are in the closed position. A meeting edge seal structure **84** is provided between the meeting edges **80** of the hoistway doors **16***a* and **16***b* to seal the meeting edge space **82** when the hoistway doors are in the closed position.

As best seen in FIG. **8***a*, an elongated meeting edge seal **86** is securely attached to the meeting edge **80** of the left hoistway door **16***a* and extends along the length of the meeting edge. The meeting edge seal **86** extends away from the left hoistway door's meeting edge **80** toward the meeting edge of the right hoistway door **16***b*. When the hoistway doors **16***a* and **16***b* are in the closed position, shown in solid lines, the meeting edge seal **86** is pressed into sealable engagement with the meeting edge **80** of the right hoistway door **16***b*, thereby sealing the meeting edge space **82**. In the preferred embodiment, the meeting edge seal **86** is a shaped resilient temperature resistive material that is slightly compressed when the hoistway doors **16***a* and **16***b* are moved to the closed position.

In an alternate embodiment illustrated in FIG. **8***b*, the meeting edge seal structure **84** includes an elongated meeting edge seal **87***a* securely attached to the meeting edge **80** of the left hoistway door **16***a*, and a similar elongated meeting edge seal **87***b* securely attached to the length of the meeting edge **80** of the right hoistway door **16***b* opposite the left meeting edge seal **87***a*. The left and right meeting edge seals **87***a* and **87***b* extend away from their respective meeting edges **80** and toward each other such that when the hoistway doors **16***a* and **16***b* are in the closed position, shown in solid lines, the meeting edge seals press against and sealably engage each other. The sealably engaged meeting edge seals **87***a* and **87***b* extend across the meeting edge space **82** and form a seal therein. In the illustrated embodiment, each of the left and right meeting edge seals **87***a* and **87***b* are constructed of a shaped resilient temperature resistive material that is positioned substantially along the meeting edges **80** of the respective hoistway doors **16***a* and **16***b*. Accordingly, the meeting edge seals **87***a* and **87***b* press against each other and slightly compress in order to form an effective seal therebetween, for example, to block the flow of gas and smoke through the meeting edge space in the event of a fire.

Therefore, when the hoistway doors **16***a* and **16***b* illustrated in FIG. **2** are moved from the open and raised position to the closed and lowered position, the hoistway doors move laterally and downwardly just as the doors reach the closed position. When the hoistway doors **16***a* and **16***b* are in the closed position, seals are formed around the hoistway entrance **14** between the hoistway door assembly **16** and the wall structure **10** and between the meeting edges **80** of the hoistway doors **16***a* and **16***b*. Thus, all of the spaces around and between the hoistway doors **16***a* and **16***b* are effectively sealed off with the seals **23** when the doors are in the closed and lowered position, for example, to limit the flow of gas or smoke between the doors and the hoistway entrance in the event of a fire, thereby minimizing migration of smoke through a building.

Although the embodiments described herein are described in terms of the seals **23** around and between the hoistway doors blocking the flow of smoke and gas in the event of a fire, the seals also block the flow of air or other gas between the hoistway door and the wall structure during normal operation or maintenance of the hoistway.

In an alternate embodiment of the present invention, as illustrated in FIG. **9**, a single hoistway door **88** is movably supported on an elongated support member **90** by a pair of door supports **32** in the manner discussed above. The single hoistway door **88** moves between an open position, shown in phantom, that permits access to the elevator cab **18**, and a closed position, shown in solid lines, wherein the hoistway door substantially covers the hoistway entrance **14**. The door support member **90** is rigidly secured to the headwall **30** with brackets **92** in a generally horizontal orientation above the hoistway entrance **14**. The door support member **90** is configured to move the hoistway doors downwardly relative to the hoistway entrance **14** as described above and illustrated in FIG. **3**. Seals are formed between the transverse edge portion **52** of the door and the headwall **30** and between the bottom edge **44** of the door and the sill **26**, as discussed above. Similarly, seals are formed between the trailing edge portion **68** of the hoistway door and the left jambwall **70***a* similar to the tailing edge seal structure **74** discussed above.

The single hoistway door **88** includes a leading edge portion **94** that is positioned outwardly away from the right jambwall **70***b* to define a leading edge lateral space **96** between the hoistway door and the jambwall. A leading edge seal structure **98** is mounted to the right jambwall **70***b* and positioned such that the leading edge portion **94** of the hoistway door **88** moves into sealable engagement therewith when the hoistway door is in the closed position, thereby sealing the leading edge lateral space **96**.

As best seen in FIG. **10***a*, the leading edge seal structure **98** has an elongated leading, edge lateral extension **100** that has an L-shaped cross-section with an attachment leg **102** of the extension securely fastened to the right jambwall **70***b*. An engagement leg **104** of the leading edge lateral extension **100** extends perpendicularly away from the right jambwall **70***b* and substantially parallel to the leading edge portion **94** of the single hoistway door **88**. An elongated leading edge lateral seal **106** is securely attached to the engagement leg **104** along the length of the lateral extension **100**. The leading edge lateral seal **106** extends toward the hoistway door **88** such that when the hoistway door is in the closed position, the leading edge portion **94** of the hoistway door sealably engages the leading edge lateral seal **106**. Accordingly, the leading edge lateral seal **106** extends across the leading edge lateral space **96** and forms a seal therein between the lateral extension **100** and the single hoistway door **88**.

In the preferred embodiment, the engagement leg **104** is a substantially rigid, blade-like member and the leading edge lateral seal **106** is a shaped, resilient temperature resistive material that is slightly compressed by the leading edge portion **94** of the hoistway door **88** when the hoistway door is in the closed position.

In an alternate embodiment of the leading edge seal structure **98**, illustrated in FIG. **10***b*, the leading edge lateral extension **100** is mounted to the right jambwall **70***b* as discussed above, and a leading edge lateral seal **107** is securely attached to the length of the leading edge portion **94** of the hoistway door **88**. The leading edge lateral seal **107** extends away from the leading edge portion **94** toward the leading edge lateral extension **100**. When the hoistway door **88** is in the closed position, the leading edge lateral seal **107** is pressed into sealable engagement with the engagement leg **104** of the leading edge lateral extension **100** and seals the leading edge lateral space **96**.

An alternate embodiment of the present invention is illustrated in FIG. **11***a* wherein the hoistway door seal structure **22** includes opposing left and right inner hoistway doors **108***a* and **108***b* and opposing left and right outer hoistway doors **110***a* and **110***b*. The inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* move together between an open position, shown in phantom lines that permits access to the elevator cab **18**, and a closed position, shown in solid lines, wherein the inner and outer hoistway doors substantially cover the hoistway entrance **14**.

The inner hoistway doors **108***a* and **108***b* are supported outwardly adjacent to the hoistway entrance **14** by an

elongated inner door support member **112** that is rigidly secured to the headwall **30** with brackets **114** in a generally horizontal orientation above the hoistway entrance. The outer hoistway doors **110***a* and **110***b* are supported outwardly adjacent to the inner hoistway doors **108***a* and **108***b* by an elongated outer door support member **116** that is secured to the inner door support member **112** with brackets **118**. The outer door support member **116** is secured in a generally horizontal orientation such that the inner door support member **112** is between the headwall **30** and the outer support member.

Each of the inner hoistway doors, **108***a* and **108***b* are movably supported on the inner door support member **112** by a pair of the door supports **32** discussed above. The inner door support member **112** has lowered portions **42** therein that are positioned to receive the support rollers **36** of the door supports **32** as the inner hoistway doors **108***a* and **108***b* are moved from the open and raised position and approach the closed position, thereby moving the inner hoistway doors laterally and downwardly relative to the hoistway entrance **14** to the closed and lowered position.

Each of the outer hoistway doors **110***a* and **110***b* are movably supported on the outer door support member **116** by a leading door support **313** and a trailing door support **315**. The leading door support **313** is connected to the respective outer hoistway door **110***a* and **110***b* generally adjacent to the meeting edge **80**, and the trailing door support **315** is connected to the respective outer hoistway door generally adjacent to the trailing edge portion **68**. The leading door support **313** has a leading support roller **113** and the trailing door support **315** has a trailing support roller **115**, each of which travels over the outer door support member **116** as the outer hoistway doors **110***a* and **110***b* move between the open and raised position and the closed and lowered position.

The outer door support member **116** also has lowered portions **42** therein that receive the leading and trailing support rollers **113** and **115** as the outer hoistway doors **110***a* and **110***b* approach the closed and lowered position. As can be seen in FIG. **11***a*, each of the outer hoistway doors **110***a* and **110***b* travel approximately half the length of the outer door support member **116** as it moves from the open position to the closed position. Accordingly, the leading support roller **113** travels over the lowered portions **42** for the trailing support roller **115** as the outer hoistway doors **110***a* and **110***b* move between the open and closed positions.

As best seen in FIGS. **11***b* and **11***c*, the outer door support member **116** and the leading support roller **113** are constructed such that the leading support roller will not move downwardly into the lowered portion **42** for the trailing support roller **115**, while the trailing support roller is constructed to move downwardly into its lowered portion. The outer door support member **116** has a channel **117** within its upper portion along the length of the outer door support member. The sides of the channel **117** are defined by sidewalls **317** that terminate at their upper ends and provide an upper roller support surface **119**. As best seen in FIG. **11***b*, the trailing support roller **115** has a narrowed, annular outer portion **121** that is movably positioned within the channel **117** in the outer door support member **116**. The annular outer portion **121** travels in the channel **117** as the respective outer hoistway door **110***a* and **110***b* moves between the open and closed positions. The lower portion **42**, shown in hidden lines, for the trailing support roller **115** extends downwardly from the channel **117** between the sidewalls **317** such that the trailing support roller's annular outer portion **121** follows the channel downwardly into the lowered portion as the respective outer hoistway door **110***a* and **110***b* approach the closed position.

As best seen in FIG. **11***c*, the leading support roller **113** has an annular channel **123** therein that receives the top portion of the outer door support member **116**. The leading support roller **113** straddles the outer door support member **116** and travels along the upper roller support surface **119** above the channel **117** as the outer hoistway doors **110***a* and **110***b* move between the open and closed positions. Accordingly, the upper roller support surface **119** supports the leading support roller **113** above the trailing support roller's lowered portion **42** within the channel **117**, so the leading support roller will not move downwardly into the trailing support roller's lowered portion. A lowered portion **42**, shown in hidden lines, is positioned in the outer door support member **116** to receive the leading support roller **113** when the respective outer hoistway door **110***a* and **110***b* approaches the closed position. Therefore, the leading and trailing support rollers move into and out of their respective lowered portions **42** simultaneously and uniformly only when the outer hoistway doors are moving into or out of the closed position.

The inner hoistway doors **108***a* and **108***b* are coupled to the outer hoistway doors **110***a* and **110***b* in a conventional manner, such that lateral and vertical movement of the hoistway doors is synchronized to move between the open and closed positions. The conventional interlock mechanism maintains engagement between the elevator cab door and the hoistway door as the hoistway doors are moved to and from the closed and lowered position.

As best seen in FIG. **11***a*, seals are formed between the trailing edge **68** of the inner hoistway doors **108***a* and **108***b* and the respective jambwalls **70***a* and **70***b* similar to the trailing edge seal structures **74** discussed above. Likewise, seals are formed between the transverse edge portion **52** of the inner hoistway doors **108***a* and **108***b* and the headwall **30** similar to the transverse edge seal structure **56** discussed above. Likewise, seals are formed between the bottom edge **44** of the inner hoistway doors **108***a* and **108***b* and of the outer hoistway doors **110***a* and **110***b* and the sill **26** as discussed above and illustrated in FIGS. **6***a* and **6***b*. Likewise, seals are formed between the meeting edge portion **80** of the outer hoistway doors **110***a* and **110***b* as discussed above.

The left inner hoistway door **108***a* is positioned outwardly away from the left outer hoistway door **110***a* to define an interdoor lateral space **120** between the left inner hoistway door and the left outer hoistway door. The right inner hoistway door **108***b* is positioned outwardly away from the right outer hoistway door **110***b* to define an interdoor lateral space **120** between the right inner hoistway door and the right outer hoistway door. An interdoor seal structure **122** is attached to each pair of the inner and outer hoistway doors **108***a*/**110***a* and **108***b*/**110***b*, so as to seal the interdoor spaces **120** when the hoistway doors are in the closed position.

As best seen in FIG. **12***a*, the interdoor seal structure **122** includes an elongated interdoor lateral extension **124** secured to the trailing edge portion **68** of each of the outer hoistway doors **110***a* and **110***b* such that the interdoor lateral extension extends along the height of the respective hoistway door. The interdoor lateral extension **124** extends inwardly toward the respective inner hoistway door **108***a* and **108***b* and into the interdoor lateral space **120**. An elongated interdoor lateral seal **126** is connected to each of the inner hoistway doors **108***a* and **108***b* adjacent to the leading edge portion **94** such that the interdoor lateral seal

extends into the interdoor lateral space **120** in an overlapping relationship with the associated interdoor lateral extension **124**.

When the hoistway doors **108***a*, **108***b*, **110***a* and **110***b* are moved to and from the open position, shown in phantom lines, the interdoor lateral extension **124** does not the respective interdoor lateral seal **126**, thereby minimizing frictional resistance to lateral movement of the hoistway doors. When the hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* are moved to the closed position, as shown in solid lines in FIG. **12***a*, the interdoor lateral extension **124** presses against and sealably engages the interdoor lateral seal **126** to seal the interdoor lateral space **120** along the height of the hoistway doors, for example, to block the flow of gas or smoke through the interdoor lateral space **120** in the event of a fire or the like. In the preferred embodiment, the interdoor lateral extension **124** is a substantially rigid, blade-like member and the interdoor lateral seal **126** is shaped, resilient temperature resistive material that is slightly compressed by the interdoor lateral extension when the hoistway doors **108***a*, **108***b*, **110***a* and **110***b* are in the closed position.

In an alternate embodiment illustrated in FIG. **12***b*, the interdoor lateral seal structure **122** includes an elongated interdoor lateral extension **125** that is secured to the leading edge portion **94** of each of the left and right inner hoistway doors **108***a* and **108***b*, and that projects outwardly toward the respective outer hoistway doors **110***a* and **110***b*. An elongated interdoor lateral seal **127** is securely attached to each of the outer hoistway doors **110***a* and **110***b* adjacent to the trailing edge portion **68** and extends into the interdoor lateral space **120** toward the respective inner hoistway door **108***a* and **108***b*. The interdoor lateral seal **127** is positioned in an overlapping relationship with the associated interdoor lateral extension **125**. When the hoistway doors **108***a*, **108***b*, **110***a* and **110***b* move to and from the open position shown in phantom lines, the interdoor lateral seal **127** is not in engagement with the interdoor lateral extension **125**. When the hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* are in the closed position shown in solid lines, the interdoor lateral seal **127** presses against the interdoor lateral extension **125** and provides a seal in the interdoor lateral space **120**. **120**.

As best seen in FIG. **11***a*, the transverse edge portion **52** of the outer hoistway doors **110***a* and **110***b* are positioned outwardly adjacent to the inner hoistway doors **108***a* and **108***b* and the headwall **30** to define a transverse head space **128** when the outer hoistway doors **110***a* and **110***b* are in the closed position. An elongated transverse head seal structure **130** is mounted to the headwall **30** between the inner hoistway doors **108***a* and **108***b* and extends outwardly from the headwall **30** toward the outer hoistway doors **110***a* and **110***b* to substantially fill the transverse head space **128**.

As best seen in FIG. **13***a*, the elongated transverse head seal structure **130** comprises an elongated transverse extension **136** that is securely fastened to the length of the transverse edge portion **52** of each outer hoistway door **110***a* and **110***b* and that extends away from its respective outer hoistway door **110***a* and **110***b* into the transverse head space **128** toward the headwall **30**. An elongated transverse head panel **132** is mounted to the headwall **30** between the inner hoistway doors **108***a* and **108***b*. The transverse head panel **132** extends outwardly from the headwall **30** into the transverse head space **128** toward the outer hoistway doors **110***a* and **110***b*. An elongated transverse head panel seal **138** is secured along the length of the transverse head panel **132** and extends upwardly away from the transverse head panel toward the transverse extension **136** in such a position wherein the transverse extension **136** is in an overlapping relationship with the transverse head panel seal.

The transverse extension **136** is out of engagement with the transverse head panel seal **138** when the respective outer hoistway doors **110***a* and **110***b* are in the open and raised position, shown in phantom lines, thereby avoiding frictional resistance between the transverse extension and the transverse head panel seal. When the outer hoistway doors **110***a* and **110***b* are moved to the closed and lowered position shown in solid lines, the transverse extension **136** moves downwardly into sealable engagement with the transverse head panel seal **138** and seals the transverse head space **128** adjacent to the outer hoistway doors. In the preferred embodiment, the transverse extension **136** is a substantially rigid, blade-like member and the transverse head panel seal **138** is a shaped, resilient temperature resistive material that is slightly compressed by the transverse extension **136** when the outer hoistway doors **110***a* and **110***b* are in the closed position.

In an alternate embodiment illustrated in FIG. **13***b*, the transverse head panel **132** is mounted to the headwall **30** as described above. An elongated transverse head panel seal **139** is mounted to each of the outer hoistway doors **110***a* and **110***b* along the length of the door near the transverse edge **52**. The transverse head panel seal **139** extends inwardly into the transverse head space **128** and is positioned in an overlapping relationship with the transverse head panel **132** such that, when the outer hoistway doors **110***a* and **110***b* are in the closed position, shown in solid lines, the transverse head panel seal is pressed into sealable engagement with the transverse head panel, thereby providing a seal within the transverse head panel space **128**.

In another embodiment of the present invention illustrated in FIG. **14**, a sloped door support member **140** is securely mounted to the headwall **30** above the hoistway entrance **14**. The sloped door support member **140** slopes downwardly from each of its outer ends toward the center of the hoistway entrance **14**. The sloped door support member **140** is illustrated with the opposing hoistway doors **16***a* and **16***b* discussed above. Although the illustrated embodiment includes a pair of opposing doors **16***a* and **16***b*, the door assembly **16** can have other configurations, such as a single door configuration, or a configuration having a multiple pair of opposing doors.

Each of the hoistway doors **16***a* and **16***b* are movably supported on the sloped door support member **140** by a pair of door supports **142** that move laterally along the sloped door support member as the hoistway doors move between the open and closed positions. Each door support **142** includes a door support truck **144** secured to the top of the respective hoistway door **16***a* or **16***b* and a support roller **146** rotatably attached to the top of the door support truck. The support roller **146** is adapted to movably engage a roller support surface **148** on the top of the sloped door support member **140** to permit the lateral movement of the hoistway doors **16***a* and **16***b* between the open and closed positions.

When the hoistway doors **16***a* and **16***b* are in the open position, shown in phantom lines, the door supports are located at the raised ends of the sloped door support member **140**, such that the doors are in a raised position above the sill **26**. As the hoistway doors **16***a* and **16***b* move from the open and raised position to the closed position, the support rollers **146** move laterally and downwardly alone the upper roller support surface **148** of the sloped door support member **140**, thereby causing the hoistway doors **16***a* and **16***b* to simultaneously move downwardly relative to the wall structure **10** to a lowered position such that the bottom edge of each hoistway door moves downwardly toward the sill **26**.

The seal structures around the hoistway entrance and the hoistway doors, and the alternative embodiments of the seal

structures are the same as the seal structures described above. The transverse seal structure **56** is mounted between the top portion of the hoistway doors and the headwall **30**. The trailing edge seal structure **74** is mounted between the trailing edge portion of the respective hoistway doors and the left and right jambwalls **70***a* and **70***b*. The meeting edge seal structure **84** is mounted between the meeting edges **80** of the doors. The bottom door seal structure **64** is mounted between the bottom edge of the door and the sill **26**. These seal structures form the seals **23** around and between the hoistway doors **16***a* and **16***b* when the hoistway doors **16***a* and **16***b* laterally and downwardly move from the open and raised position to the closed and lowered position. Accordingly, the sloped door support member **140** simultaneously directs the hoistway doors laterally and vertically, thereby forming seals that, for example, block the flow of smoke and gas between the hoistway doors **16***a* and **16***b* and the wall structure.

As best seen in FIG. **15**, the sloped door support member **140** is oriented to provide a gradual transition for the support rollers **146** as the hoistway doors **16***a* and **16***b* move between the closed and lowered position shown in solid lines, and the open and raised position shown in phantom lines. Accordingly, as the left and right hoistway doors **16***a* and **16***b* are moved laterally from the closed position toward the open position, the support rollers **146** travel upwardly along the roller support surface **148**, thereby lifting the hoistway doors from the lowered position to the raised position. As a result, the hoistway doors **16***a* and **16***b* avoid frictional resistance from the seal structures and can be moved to the open position with a minimal amount of force.

In another embodiment of the present invention illustrated in FIG. **16**, the hoistway entrance **14** in the wall structure **10** is a rectangular opening defined by the left lateral jamb **24***a*, the right lateral jamb **24***b*, the sill **26**, and the head **28**. The hoistway door seal structure **22** is adjacent to the hoistway entrance **14**. The hoistway door seal structure **22** includes the hoistway door assembly **16** that moves laterally relative to the hoistway entrance **14** between the open position, shown in phantom lines, permitting access to the elevator hoistway, and the closed position, shown in solid lines, wherein the hoistway door assembly **16** substantially covers the hoistway entrance **14**. In the illustrated embodiment, the hoistway door assembly **16** includes the pair of opposing doors **16***a* and **16***b* that are laterally movable relative to the hoistway entrance **14**. The pair of opposing doors **16***a* and **16***b* are coupled together in a conventional manner, such that the lateral movement of each of the hoistway doors is synchronized to move together between the open and closed positions. Although the illustrated embodiment includes the pair of opposing doors **16***a* and **16***b*, the door assembly can have other configurations, such as the single door configuration, or the configuration having a multiple pair of opposing doors.

The pair of hoistway doors **16***a* and **16***b* are movably supported outwardly adjacent to the hoistway entrance **14** by a segmented door support member **152** that is securely mounted to the headwall **30** above the head **28** in a generally horizontal orientation. Each of the hoistway doors **16***a* and **16***b* are movably attached to the segmented door support member **152** by a pair of door supports **154** that move laterally along the segmented door support member as the hoistway doors move between the open and closed positions. Each door support **154** includes a door support truck **156** that is pivotally secured to the top of the respective hoistway door **16***a* and **16***b*, and a support roller **158** is rotatably attached to the top of the door support truck **156**. The support roller **158** movably engages a roller support surface **160** on the top of the segmented door support member **152** to permit the lateral movement of the hoistway doors **16***a* and **16***b* between an open and closed position.

The hoistway door seal structure **22** further includes the plurality of seals positioned between the hoistway doors **16***a* and **16***b* and the wall structure **10** around the hoistway entrance **14**, and, as discussed in detail below, the seals are adapted to seal spaces between the hoistway doors and the wall structure when the doors are in the closed position, for example, to restrict the passage of gas and smoke through the spaces in the event of a fire. The formation of these seals is facilitated by the segmented door support member **152**, which is constructed to guide the hoistway doors **16***a* and **16***b* laterally as the doors move from the open position shown in phantom lines toward the closed position shown in solid lines. As the hoistway doors **16***a* and **16***b* approach the closed position, the segmented door support member **152** also simultaneously guide the hoistway doors inwardly toward the wall structure, thereby forming, seals between and around the hoistway doors.

As best seen in FIGS. **16** and **17**, the segmented door support member **152** is a substantially horizontal rail sized to the opening distance traveled by the support rollers **158** as the hoistway doors move between the open and closed positions, with the uppermost edge of a rail forming the roller support surface **160**. The segmented door support member **152** includes a plurality of segments **161** secured to the headwall **30**, with each door support **154** traveling on a separate segment.

Each segment **161** has an elongated straight portion **162**, and a curved end portion **164** secured to the end of each straight portion closest to the center of the hoistway entrance **14**. The location of the innermost end of the curved end portion **164** corresponds to the location of the respective support roller **158** when the hoistway doors **16***a* and **16***b* are in the closed position. Each of the curved end portions **164** is positioned to receive the support roller **158** from the straight portions **162** as the hoistway doors **16***a* and **16***b* approach the closed position. As best seen in FIG. **18**, the straight portion **162** of each segment **161** is positioned outwardly away from the headwall **30** such that the corresponding hoistway door **16***a* and **16***b* is supported outwardly away from the wall structure **10** as the hoistway door moves between the open and closed positions. The curved end portion **164** curves inwardly from the end of the straight portion **162** and terminates at the headwall **30**.

Accordingly, each of the support rollers **158** travel along the roller support surface **160** of the respective segment **161** such that the hoistway doors **16***a* and **16***b* are in the outward position, shown in phantom lines in FIG. **18**, as the support rollers travel over the support member's straight portion **162**. As the hoistway doors **16***a* and **16***b* move laterally from the open and outer position and approach the closed position, the support rollers **158** move from the straight portions **162** to their respective curved end portions **164**, thereby causing the hoistway doors **16***a* and **16***b* to simultaneously move laterally and inwardly, relative to the wall structure, to the closed position.

As best seen in FIG. **17**, the door support truck **156** has an upper portion **157** that rotatably carries the support roller **158**, and a lower portion **159** that is securely fastened to the respective hoistway door **16***a* and **16***b*. The upper and lower portions **157** and **159** are connected to each other by a pivotal member **166** such that the upper portion is pivotal relative to the lower portion and relative to the hoistway

door. As seen in FIGS. **17** and **18**, each of the support rollers **158** movably engages the roller support surface **160** and, as the hoistway doors **16***a* and **16***b* move laterally from the open and outward position toward the closed and inward position, the upper portion **157** of the door support truck **156** pivots as the support roller **158** follows the curved end portion **164**, thereby causing the hoistway doors **16***a* and **16***b* to simultaneously move inwardly toward the hoistway entrance **14**.

As best seen in FIG. **18**, the terminating end **170** of the straight portion **162** of each segment **161** is attached to the headwall **30** with brackets **168**. The curved end portion **164** opposite the terminating end **170** is secured directly to the headwall. The segments **161** of the segmented door support member **152** are constructed so the support rollers **158** simultaneously travel over the same area of their respective segment such that the hoistway doors **16***a* and **16***b* move in a uniform manner and remain substantially parallel to the hoistway entrance **14** as they move between the open and closed positions.

In an alternate embodiment of the segmented support member **152**, illustrated in FIG. **19**, the segmented support member **152** is a substantially horizontal rail with the uppermost edge of the rail forming a roller support surface **172**. Each of the hoistway doors **16***a* and **16***b* are movably attached to the segmented door support member **152** by a pair of the non-pivotal door supports **32** described generally above and illustrated in FIG. **3**. The segmented door support member **152** includes a plurality of segments **173**, each having a straight portion **174** and a narrowed, curved portion **176** that is connected to the end of the straight portion **174**. Each of the narrowed, curved portions **176** is positioned to receive the support roller **158** when the hoistway doors **16***a* and **16***b* approach the closed position. As the hoistway doors **16***a* and **16***b* are moved laterally from the open and outward position shown in phantom lines toward the closed and inward position, the support rollers **158** move from the straight portion **174** and follow the narrowed, curved portion **176** as the hoistway doors approach the closed position.

As best seen in FIG. **20***a*, the support roller **36** has an annular groove **178** therein that receives the top of the door support member **152**, such that the support rollers straddles the door support member. The straight portion **174** of the segmented door support member **152** is sized slightly narrower than the width an annular groove **178** so as to minimize the frictional resistance between the support roller and the roller support surface **172**. When the hoistway doors are in the closed position, the support rollers **36** are located at a position on the respective narrowed, curved portion **176**, as best seen in FIG. **20***b*, where the narrowed, curved portion has a thickness that is approximately less than half the width of the annular groove **178**. The narrowed, curved portion **176** is shaped and sized to direct the respective non-pivotal support roller **36** inwardly as the hoistway door approaches the closed position. The annular groove **178** is shaped to accommodate the curvature of the narrowed, curved portion **176** so the non-pivotal support roller **36** travels freely over the narrowed, curved portion without binding or experiencing excessive frictional resistance between the sides of the annular groove and the segmented door support member **152**.

As best seen in FIGS. **18** and **19**, each of the hoistway doors **16***a* and **16***b* have the transverse edge portion **52** along the top of the door that is outwardly adjacent to the headwall **30** so as to define the transverse space **54** between the transverse edge and the headwall **30**. An elongated transverse seal structure **179** is positioned between the transverse edge portion **52** and the headwall **30** such that when the hoistway doors **16***a* and **16***b* are in the closed position as shown in solid lines, the elongated transverse seal structure **179** substantially fills the transverse space **54**, for example, so as to block the passage of gas or smoke therethrough in the event of a fire or the like.

As best seen in FIG. **21***a*, the elongated transverse seal structure **179** comprises an elongated transverse seal **180** securely fastened to the headwall **30** adjacent to the head **28**. The transverse seal **180** extends outwardly toward the hoistway doors **16***a* and **16***b* and into the transverse space **54**. The transverse seal **180** is out of engagement with the hoistway doors **16***a* and **16***b* when the doors are in the open and outward position shown in phantom lines, thereby avoiding frictional resistance between the transverse seal **180** and the hoistway door. When the hoistway doors **16***a* and **16***b* are moved from the open and outward position to the closed and inward position, the hoistway doors move into sealable engagement with the transverse seal **180** so as to seal the transverse space **54**. In the preferred embodiment, the transverse seal **180** is a shaped, resilient temperature resistive material that is slightly compressed by the top of the hoistway doors **16***a* and **16***b* when it is moved to the closed and inward position.

In an alternate embodiment illustrated in FIG. **21***b*, the elongated transverse seal structure **179** comprises elongated transverse seals **181** attached to the top portion of each of the hoistway doors **16***a* and **16***b* adjacent to the transverse edge portion **52**. Each transverse seal **181** extends along the length of the respective hoistway door **16***a* and **16***b*, and the transverse seal extends inwardly into the transverse space **54** toward the headwall **30**. When the hoistway doors **16***a* and **16***b* are in the closed and inward position shown in solid lines, the elongated transverse seal **181** presses against the headwall **30** to form a seal in the transverse space **54**.

Referring to FIG. **16**, the bottom edge **44** of each hoistway door **16***a* and **16***b* is positioned above the sill **26** at a selected distance that defines a sill space **46** between the hoistway doors and the sill. As best seen in FIG. **22**, a bottom door seal structure **182** is securely attached to the entire bottom edge **44** of each of the hoistway doors **16***a* and **16***b*. The bottom edge seal structure **182** includes elongated inner and outer bottom seals **184***a* and **184***b* spaced apart on the bottom edge **44** of each hoistway door **16***a* and **16***b*, such that the inner and outer bottom seals **184***a* and **184***b* extend the length of the respective hoistway door, and the bottom seals extend downwardly toward the sill **26**. The bottom door seals **184***a* and **184***b* are sized such that they substantially fill the sill space **46** so as to, as an example, limit the flow of gas or smoke therethrough in the event of a fire. In the preferred embodiment, the bottom door seals **184***a* and **184***b* are a stainless steel brushes that lightly touches the sill as the hoistway doors **16***a* and **16***b* are moved to the closed position thereby minimizing frictional resistance during movement of the hoistway doors.

As best seen in FIG. **16**, each of the hoistway doors **16***a* and **16***b* has a trailing edge portion **68** that is positioned outwardly adjacent to the respective left and right jambwalls **70***a* and **70***b*. As best seen in FIG. **23***a*, each of the hoistway doors **16***a* and **16***b* is positioned such that the trailing edge lateral space **72** is located between the hoistway doors **16***a* and **16***b* adjacent to the trailing edge portion **68** and the respective left and right jambwall **70***a* and **70***b*. An elongated trailing edge seal **186** is connected to the left and right jambwalls **70***a* and **70***b* along their length. The trailing edge seal **186** projects outwardly from the respective **70***a* and **70***b* toward the respective hoistway door **16***a* and **16***b* such that

the trailing edge seal **186** extends into the trailing edge space **72**. The hoistway doors **16***a* and **16***b* are out of engagement with the respective trailing edge seal **186** when the hoistway doors are in the open and outward position, thereby avoiding frictional resistance therebetween as the doors are moving between the open and closed positions.

When the hoistway doors **16***a* and **16***b* are moved to the closed and inward position, as shown in solid lines in FIG. **23***a*, the hoistway doors **16***a* and **16***b* pressed against and sealably engages the trailing edge seal **186** to seal the trailing edge space **72** alone the height of the hoistway doors. In the preferred embodiment, the trailing edge seal **186** is a shaped, resilient temperature resistive material that is slightly compressed by the hoistway door when it is moved to the closed and inward position.

In an alternate embodiment illustrated in FIG. **23***b*, an elongated trailing edge seal **187** is attached to the entire length of the hoistway door **16***a* and **16***b* near the trailing edge portion **68** and extends into the trailing edge space **72** toward the jambwalls **70***a* and **70***b*. Accordingly, when the hoistway doors **16***a* and **16***b* are moved from the open and outward position shown in phantom lines toward the closed and inward position shown in solid lines, the trailing edge lateral seals **187** press against the respective right and left jambwalls **70***a* and **70***b* to form a seal in the trailing edge space **72**.

The meeting edge seals and their alternate embodiments are as described above and shown in FIGS. **8***a*/*b*. The interdoor seals and the alternate embodiments for a pair or multiple pair of hoistway door configurations are as described above and shown in FIGS. **12***a*/*b*.

In an alternate embodiment (not shown) of the present invention having the segmented door support structure **152**, the door seal structure **22** includes the single hoistway door **88** having the leading edge portion **94** that is positioned outwardly away from the right jambwall **70***b* to define a leading edge lateral space **96** between the hoistway door and the jambwall. As best seen in FIG. **24***a*, a leading edge lateral seal **188** is attached to the right jambwall **70***b* and projects outwardly away from the jambwall into the leading edge lateral space **96** toward the hoistway door **88**. The leading edge lateral seal **188** is out of engagement with the jambwall **70***b* when the hoistway door **88** is in the open and outward position, thereby avoiding frictional resistance between the leading edge lateral seal **188** and the jambwall **70***b* as the door is moving between the open and closed positions. When the hoistway door **88** is moved to the closed and inward position, the hoistway door **88** moves inwardly into sealable engagement with the leading edge lateral seal **188** so as to seal the leading edge space **96**. In the preferred embodiment, the leading edge lateral seal **188** is a shaped, resilient temperature resistive material that is slightly compressed by the hoistway door **88** near the leading edge portion **94** when the hoistway door is moved to the closed and inward position.

In an alternate embodiment, illustrated in FIG. **24***b*, a leading edge lateral seal **189** is mounted to the hoistway door **88** near the leading edge portion **94** along the height of the door, and the leading edge lateral seal extends inwardly toward the right jambwall **70***b* and into the leading edge space **96**. As the hoistway door **88** is moved from the open and outward position, shown in phantom lines, into the closed and inward position, shown in solid lines, the leading edge seal **189** is pressed into sealable engagement with the jambwall **70***a* to form a seal therein, for example, that limits smoke and gas flow through the leading edge space **96** in the event of a fire or the like.

In a single hoistway door configuration, seals are formed between the transverse edge of the door and the headwall as discussed above and illustrated in FIGS. **21***a* and **21***b*, between the bottom edge of the door and the sill as discussed above and illustrated in FIG. **22**, and between the trailing edge of the door and the jambwall as discussed above and shown in FIGS. **23***a* and **23***b*.

In an alternative embodiment of the present invention, the hoistway door seal structure **22** includes a segmented door support member **152**, as discussed above, and the door assembly includes opposing left and right inner hoistway doors **108***a* and **108***b* and opposing left and right outer hoistway doors **110***a* and **110***b*, similar to the hoistway door arrangement illustrated in FIG. **16**. As best seen in FIG. **25***a*, the transverse edge portion **52** of the outer hoistway doors **110***a* and **110***b* is outwardly adjacent to the headwall **30**, and the elongated transverse head panel seal structure **124** is attached to the headwall **30** between the headwall and the transverse edge portion **52** of the outer hoistway doors **110***a* and **110***b*. The transverse head panel seal structure includes a transverse head panel **191** having an L-shaped cross section with a first leg **193** securely attached to the headwall **30** and extending outwardly substantially perpendicular to the headwall. An upwardly projecting second leg **192** is connected to the outward end of the first leg **193** adjacent to the transverse edge portion **52** of the outer hoistway doors **110***a* and **110***b*. A transverse head panel space **194** is located between the upwardly projecting second leg **192** and the transverse edge portions of outer hoistway doors **110***a* and **110***b*.

An elongated transverse head panel seal **196** is secured along the length of the upwardly projecting second leg **192** of the transverse head panel **191** and extends toward the outer hoistway doors **110***a* and **110***b* into the transverse head panel space **194**. The transverse head panel seals **196** are out of engagement with the outer hoistway doors **110***a* and **110***b* when the respective doors are moved to and from the open and outward position, thereby avoiding frictional resistance between the transverse head panel seal **196** and the outer hoistway doors **110***a* and **110***b*. When the outer hoistway doors **110***a* and **110***b* are moved to the closed and inward position, they move into sealable engagement with the transverse head panel seal **196** so as to seal the transverse head panel space **194**. In the preferred embodiment, the transverse head panel seal **196** is a shaped, resilient temperature resistive material that is slightly compressed by the outer hoistway door **110***a* and **110***b* when the hoistway doors are moved to the closed and inward position.

In an alternate embodiment illustrated in FIG. **25***b*, the transverse head panel seal **197** is mounted to the outer hoistway doors **110***a* and **110***b* near the transverse edge portion **52** along the length of the respective outer hoistway door, and the transverse head panel seal extends inwardly toward the upwardly projecting second leg **192** of the transverse head panel **191** such that when the outer hoistway doors **110***a* and **110***b* are in the closed and inward position, shown in solid lines, the transverse head panel seal **197** is pressed into sealable engagement with the upwardly projecting second leg **192** thereby forming a seal within the transverse head panel space **194**.

In the alternate embodiments having the segmented door support member **152** and a door assembly having opposing inner and outer hoistway doors, **108***a*, **108***b*, **110***a*, and **110***b*, as illustrated in FIGS. **25***a* and **25***b*, seals are formed between the transverse edge portion **52** of the inner hoistway doors and the headwall **30** as described above and illustrated in FIGS. **21***a* and **21***b*. Thus, the transverse seal **180** is

securely connected to the headwall **30**, or alternatively to the top portion of each inner hoistway door **108***a* and **108***b*, and the transverse seal is slightly compressed when the inner hoistway doors are in the closed and inward position. A sill seal is formed between the bottom edge of the inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b*, and the sill **26** as discussed above and illustrated in FIG. **22**. A trailing edge seal structure **186** is attached to the trailing edge portion of the inner hoistway doors **108***a* and **108***b*, or alternatively to the respective left and right jambwall **70***a* and **70***b* in a manner substantially identical as is described above and illustrated in FIGS. **23***a* and **23***b* for the door assembly with two opposing door panels.

In the alternate embodiments having the segmented door support member **52** and a door assembly with inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b*, the hoistway doors move in unison from the outward position to the inward position as the hoistway doors close. Accordingly, the interdoor lateral space **120** between the leading edge portions of the inner hoistway doors **108***a* and **108***b* and the trailing edge portions of the outer hoistway doors **110***a* and **110***b* remain substantially the same size as the hoistway doors move between the open and outward position and the closed and inward position. Accordingly, the interdoor lateral space **120** is sealed by an interdoor seal structure **122** in the same manner as discussed above and illustrated in FIGS. **12***a* and **12***b*.

When the inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* move from the open and outward position, shown in solid lines in FIG. **16**, to the closed position, shown in phantom lines, the inner and outer hoistway doors move laterally and inwardly as the doors approach and reach the closed and inward position. When the inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* are in the closed and inward position, seals are formed around and between the inner and outer hoistway doors **108***a*, **108***b*, **110***a*, and **110***b* and are effectively sealed off, for example, to limit the flow of gas or smoke therethrough in the event of a fire, thereby minimizing migration of smoke through a building during a fire or the like.

In yet another embodiment of the present invention illustrated in FIG. **26**, a door assembly **16** has a pair of opposing hoistway doors **202***a*and **202***b* that are supported outwardly adjacent to the hoistway entrance **14** by an elongated door support member **198**. The door support member **198** is rigidly secured to the headwall **30** by brackets **200** in a generally horizontal orientation above the hoistway entrance **14**. Although the illustrated embodiment includes a pair of opposing doors **202***a* and **202***b*, the door assembly **16** can have other door configurations, such as a single door, or a multiple pair of opposing doors, as discussed above.

As best seen in FIGS. **26** and **27**, the elongated door support member **198** is a rail with a horizontal top edge **203** and a sloped bottom edge **204** that slopes downwardly from each of its outer ends toward the centerline of the hoistway entrance **14**. The sloped bottom edge **204** is directly above the hoistway doors **202***a* and **202***b*. Each of the hoistway doors **202***a* and **202***b* have a sloped transverse edge **206** that slopes downwardly from the hoistway door's trailing edge portion to its leading edge portion. The slope of the sloped transverse edge **206** substantially correspondences to the slope of the door support member's sloped bottom edge **204**.

As best seen in FIG. **26**, each of the hoistway doors **202***a* and **202***b* are movably supported on the door support member **198** by a leading door support **212***a* and a trailing door support **212***b* that move laterally along the horizontal top edge **203** as the hoistway doors move laterally between the open and closed positions. Each of the leading and trailing door supports **212***a* and **212***b* includes a door support truck **214** secured to the top of the respective hoistway door **202***a* and **202***b*, and a support roller **216** rotatably attached to the top of the door support truck. The support roller **216** rolls along the door support member's horizontal top edge **203** upon movement of the hoistway doors.

The door support trucks **214** of the leading and trailing door supports **212***a* and **212***b* are sized such that the sloped transverse edge **206** of the respective hoistway door **202***a* and **202***b* is immediately adjacent to the door support member's sloped bottom edge **204** when the hoistway doors are in the closed position. Accordingly, the door support truck **214** of the leading door support **212***a* is longer than the door support truck **214** of the trailing door support **212***b* to accommodate the deeper section of the door support member near its middle portion. When the hoistway doors **202***a* and **202***b* are moved toward the open position, the distance between the hoistway door's sloped transverse edge **206** and the door support member's sloped bottom edge **204** increases because of the slope of the sloped bottom edge.

As best seen in FIGS. **28***a* and **28***b*, the door support member **198** is outwardly supported away from the headwall **30** by the brackets **200** to define a transverse door support space **208** between the door support member and the headwall **30**. A sloped transverse seal **210** is connected to the headwall **30** and extends outwardly to the door support member **198** adjacent to the sloped bottom edge **204** of the door support member **198**. The transverse seal **210** is a blade-like structure having a slope that substantially corresponds to the slope of the sloped bottom edge **203**, and the sloped transverse seal fills the transverse door support space **208** to block, for example, the flow of smoke and gas between the door support member **198** and the headwall **30**.

As best seen in FIGS. **26** and **27**, when the hoistway doors **202***a* and **202***b* are in the closed position, shown in solid lines, the sloped transverse edge **206** of each hoistway door positioned below the door support member's sloped bottom edge **204** defines a sloped transverse space **220** therebetween. As best seen in FIG. **28***a*, an elongated transverse seal **222** is attached to the door support member's sloped bottom edge **204**, and the transverse seal extends downwardly toward the sloped transverse edge **206** of hoistway doors **202***a* and **202***b* into the transverse space **220**.

When the hoistway doors **202***a* and **202***b* are in the closed position, shown in solid lines, the sloped transverse edge **206** of each hoistway door **202***a* and **202***b* sealably engages the transverse seal **222** on the door support member **198**, such that the transverse seal **222** fills the transverse space **220**, for example, to block the flow of smoke and gas between the doors **202***a* and **202***b* and the headwall **30**. When the hoistway doors **202***a* and **202***b* are moved to and from the open position, shown in phantom lines, the transverse seal **222** is out of engagement with the sloped transverse edge **206** of the hoistway doors, thereby avoiding, frictional resistance between the sloped transverse edges and the transverse seal as the hoistway doors move between the open and closed positions. In the preferred embodiment, the transverse seal **222** is a shaped, resilient temperature resistive material that is slightly compressed by the sloped transverse edges **206** when the hoistway doors **202***a* and **202***b* are moved to the closed position.

In an alternate embodiment of the present invention having the door support member **198** with a sloped bottom edge **204**, as best seen in FIG. **28***b*, the sloped transverse seal

210 extends between the door support member and the headwall 30, as discussed above. An elongated sloped transverse seal 225 is securely mounted to the sloped transverse edge 206 of each of the hoistway doors 202*a* and 202*b*. The sloped transverse seal 225 extends upwardly away from the sloped transverse edge 206 into the transverse space 220 toward the sloped bottom edge 204 of the door support member 198. When the hoistway doors 202*a* and 202*b* are in the closed position, shown in solid lines, the sloped transverse seal 225 is in sealable engagement with the door support member's sloped bottom edge 204 so as to seal the sloped transverse space 220 and block gas or smoke from flowing therethrough in the event of a fire. When the hoistway doors 202*a* and 202*b* are moved toward the open position, shown in phantom lines, the sloped transverse seal 225 moves out of engagement with the door support member 198, so as to avoid frictional resistance therebetween as the hoistway doors move between the open and closed positions.

In the embodiments having the door support member 198 with a sloped bottom edge 204, additional seals are provided around and between the hoistway doors 202*a* and 202*b*, for example, to block gas or smoke from flowing between the hoistway doors and the wall structure 10 around the hoistway entrance. As best seen in FIG. 26, a trailing edge seal structure 74 as is described above and illustrated in FIGS. 7*a* and 7*b* is positioned between the trailing edge 68 of the respective hoistway door and the respective jambwall 70*a* and 70*b*. A meeting edge seal 86 as described above and illustrated in FIGS. 8*a* and 8*b* is positioned between the meeting edges 80 of the hoistway doors. A bottom door seal structure 182 as is described above and illustrated in FIG. 22 is positioned between the bottom edge 44 of each hoistway door and the sill 26. In the embodiment (not shown) wherein a single hoistway door is movably supported on the door support member having a sloped bottom edge, a leading edge seal structure as is described above and illustrated in FIGS. 10*a* and 10*b* is positioned between the leading edge of the hoistway door and the respective jambwall.

In an alternate embodiment having opposing outer and inner hoistway doors 226*a*, 226*b*, 228*a*, and 228*b*, as best seen in FIGS. 29*a* and 29*b*, the outer hoistway doors are movably supported on an elongated outer door support member 234 and the inner hoistway doors are movably supported on an elongated inner door support member 232. Each of the inner and outer door support members 232 and 234 have a horizontal top edge 235 and a sloped bottom edge 238 that slopes downwardly toward the center of the hoistway entrance. Each of the outer and inner hoistway doors 226*a*, 226*b*, 228*a*, and 228*b* have a sloped transverse edge 240 that slopes downwardly toward the center of the hoistway entrance, and the slope of each transverse edge corresponds to the downward slope of the sloped bottom edge 238 of the respective inner and outer door support members 232 and 234. The sloped transverse edges 240 of the outer hoistway doors 226*a* and 226*b* are positioned outwardly adjacent to the inner hoistway doors 228*a* and 228*b* and the headwall 30 to define a sloped transverse head panel space 230 between the inner door support member 232 and the outer door support member 234. An outer sloped transverse seal structure 236 is mounted between the inner door support member 232 and the outer door support member 234 adjacent to the sloped bottom edge 238 to substantially fill the sloped outer transverse head panel space 230. An inner sloped transverse seal structure 237 is mounted between the inner door support member 232 and the headwall 30 adjacent to the sloped bottom edge 238 to substantially fill the sloped inner transverse head panel space 231.

As best seen in FIG. 29*a*, an elongated outer transverse seal 244 is secured to the length of the sloped bottom edge 238 of the outer door support member 234. The outer transverse seal 244 extends downwardly away from the sloped bottom edge 238 toward the sloped transverse edge 240 of the outer hoistway doors 226*a* and 226*b* into an outer transverse space 242 that is between the respective outer hoistway door and the outer door support member 234. The outer transverse seals 244 are out of engagement with the transverse edge 240 of the respective outer hoistway doors 226*a* and 226*b* when the hoistway doors are in the open position, shown in phantom lines. This arrangement avoids resistance between the outer transverse seals 244 and the sloped transverse edge 240 as the outer hoistway doors 228*a* and 228*b* are moved between the open and closed positions.

When the outer hoistway doors 226*a* and 226*b* are moved to the closed position the sloped transverse edges 240 move laterally into sealable engagement with the outer transverse seal 244, so as to seal the outer transverse space 242. The outer transverse seal 244 is preferably a shaped, resilient temperature resistive material that is slightly compressed by the sloped transverse edge 240 of the respective outer hoistway door 226*a* and 226*b* when the outer hoistway doors are in the closed position.

An elongated inner transverse seal 243 is secured to the length of the sloped bottom edge 238 of the inner door support member 232. The inner transverse seal 243 extends downwardly away from the sloped bottom edge 238 toward the sloped transverse edge 240 of the inner hoistway doors 228*a* and 228*b* into an inner transverse space 239 between the respective inner hoistway door and the inner door support member 232. The inner transverse seals 243 are out of engagement with the sloped transverse edge 240 of the respective inner hoistway doors 228*a* and 228*b* when the hoistway doors are in the open position, shown in phantom lines.

When the inner hoistway doors 228*a* and 228*b* are moved to the closed position, shown in solid lines, the sloped transverse edges 240 move laterally into sealable engagement with the inner transverse seal 243, so as to seal the inner transverse space 239. The inner transverse seal 243 is preferably a shaped, resilient temperature resistive material that is slightly compressed by the sloped transverse edge 240 of the respective inner hoistway doors 228*a* and 228*b* when the inner hoistway doors are in the closed position.

In an alternate embodiment illustrated in FIG. 29*b*, an outer transverse seal 245 is mounted to the outer hoistway door 226*a* and 226*b* along the sloped transverse edge 240 and an inner transverse seal 247 is mounted to the inner hoistway doors 228*a* and 228*b* along the sloped transverse edge 240. Each of the inner and outer transverse seals 245 and 247 extend upwardly toward the respective inner and outer door support members 232 and 234. The inner and outer transverse seals 247 and 245 extend away from the respective sloped transverse edge 240 such that when the hoistway doors are in the closed position, shown in solid lines, the inner and outer transverse seals are pressed into sealable engagement with the respective sloped bottom edges 238 so as to form a seal within the respective inner and outer transverse edge spaces 242.

In another alternate embodiment of the present invention, as illustrated in FIG. 30, an elongated door support member 246 is securely mounted to the headwall 30 above the hoistway entrance 14. The elongated door support member 246 is illustrated with the opposing hoistway doors 202*a* and 202*b* discussed above. Although the illustrated embodiment

includes a pair of opposing doors, the door assembly can have other configuration, such as a single door configuration, or a configuration having a multiple pair of opposing doors, as discussed above. Each of the hoistway doors **202***a* and **202***b* are movably attached to the elongated door support member **246** by a pair of door supports **212** as discussed above and shown in FIG. **26**.

The hoistway door seal structure **22** further includes a plurality of seals positioned between the hoistway doors **202***a* and **202***b* and the wall structure **10** around the hoistway entrance **14**, to seal spaces between the hoistway doors and the wall structure when the doors are in the closed position, for example, to restrict the passage of gas and smoke through the spaces in the event of a fire. The formation of these seals is facilitated by the elongated door support member **246**, which is constructed to move the hoistway doors **202***a* and **202***b* laterally from the open position, and as the hoistway doors approach the closed position, the door support member is adapted to move the hoistway doors into sealable engagement with the seals.

As best seen in FIGS. **30** and **31**, the elongated door support member **246** is a substantially horizontal rail with the uppermost edge of the rail forming a horizontal roller support surface **248**. A sloped transverse seal structure **250** is mounted to the headwall **30** below the elongated door support member **246** and slopes downwardly from its outer ends toward the centerline of the hoistway entrance **14** and as best seen in FIGS. **32***a* and **32***b*, has an L-shaped cross-section, wherein an attachment leg **252** of the structure is securely fastened to the headwall **30** in a conventional manner. An engagement leg **254** extends perpendicularly away from the headwall **30**. A sloped transverse edge **206** of the hoistway doors **202***a* and **202***b* substantially corresponds to the slope of the sloped transverse seal structure **250**.

As best seen in FIG. **31**, when the hoistway doors **202***a* and **202***b* are moved to the closed position, shown in solid lines, the sloped transverse edge **206** of the hoistway doors **220***a* and **202***b* are positioned below the engagement leg **254** of the sloped transverse seal structure **250** to define a sloped transverse space **256**.

As best seen in FIG. **32***a*, an elongated transverse seal **258** is secured to the length of the engagement leg **254** of the sloped transverse seal structure **250**. The elongated transverse seal **258** extends downwardly away from the engagement leg **254** toward the sloped transverse edge **206** of the hoistway doors **202***a* and **202***b*. The elongated transverse seals **258** are out of engagement with the sloped transverse edge **206** when the respective doors **202***a* and **202***b* are in the open position shown in phantom lines, thereby avoiding frictional resistance between the elongated transverse seal and the sloped transverse edge as the door moves between the open and closed positions. When the hoistway doors **202***a* and **202***b* are moved to the closed position shown in solid lines, the sloped transverse edge **206** is moved into sealable engagement with the elongated transverse seal **258** as to seal the sloped transverse space **256**. In the preferred embodiment, the elongated transverse seal **258** is a shaped, resilient temperature resistant material that is slightly compressed by the sloped transverse edge **206** when the hoistway doors **202***a* and **202***b* are moved to the closed position.

As best seen in FIG. **32***b*, an alternate embodiment of the elongated transverse seal **259** is securely mounted to the length of the sloped transverse edge **206** of the hoistway doors **202***a* and **202***b*. The elongated transverse seal **259** extends upwardly away from the sloped transverse edge **206** toward the engagement leg **254** of the sloped transverse seal structure **250**. Accordingly, when the hoistway doors **202***a* and **202***b* are moved to the closed position, shown in solid lines, the elongated transverse seal **259** moves into sealable engagement with the engagement leg **254** to seal the sloped transverse space **256**.

The seal structures along the bottom edge of the hoistway doors are as described above and illustrated in FIG. **22**. The seal structures along the trailing edges of the hoistway doors are as described above and illustrated in FIGS. **7***a* and **7***b*. The seal structures along the meeting edge of an opposing door configuration are as described above and illustrated in FIGS. **8***a* and **8***b*. In a configuration with a single hoistway door, the seal structures along the leading edge of the single hoistway door is as described above and illustrated in FIGS. **10***a* and **10***b*. In a configuration having pairs of opposing inner and outer hoistway doors, the seal structures along the trailing edge of the outer hoistway door and the leading edge of the inner hoistway door are as described above for a pair or multiple pairs of hoistway doors and illustrated in FIGS. **12***a* and **12***b*.

In an alternate embodiment, illustrated in FIGS. **33***a* and **33***b*, the sloped transverse edge **240** of the outer hoistway doors **226***a* and **226***b* are positioned outwardly adjacent to the inner hoistway doors **228***a* and **228***b*, and to the headwall **30** to define a sloped transverse head panel space **260**. A sloped transverse seal structure **262** is mounted to the headwall **30** above the hoistway entrance and below inner and outer elongated door support members **263** and **265** that are also mounted to the headwall. The sloped transverse seal structure **262** slopes downwardly from its outer ends toward the centerline of the hoistway entrance and has an L-shaped cross section, wherein an attachment leg **264** of the structure is securely fastened to the headwall **30** in a conventional manner. An engagement leg **266** extends perpendicularly away from the headwall **30**. The sloped transverse edge **240** of the outer hoistway doors **226***a* and **226***b* substantially corresponds to the slope of the sloped transverse seal structure **262**. When the outer hoistway doors **226***a* and **226***b* are moved to the closed position, shown in solid lines, the transverse edge **240** of the outer hoistway doors **226***a* and **226***b* are outwardly positioned from the engagement leg **266** to define a sloped transverse space **268**. The outer ends of the sloped transverse seal structure **262** terminate at a positioned above the left and right jambwalls **70***a* and **70***b* (shown in FIG. **30**), such that the sloped transverse seal structure does not interfere with lateral movement of the inner hoistway doors **228***a* and **228***b* as they move toward the closed position.

As best seen in FIG. **33***a*, an elongated sloped transverse seal **270** is secured to the length of the engagement leg **266** of the sloped transverse seal structure **262**. The elongated sloped transverse seal **270** projects downwardly away from the engagement leg **266** toward the sloped transverse edge **240** of the outer hoistway doors **226***a* and **226***b* into the sloped transverse space **268**. The elongated sloped transverse seals **270** are out of engagement with the sloped transverse edge **240** when the respective outer hoistway doors **226***a* and **226***b* are in the open position shown in phantom lines. When the outer hoistway doors **226***a* and **226***b* are moved to the closed positions shown in solid lines, the sloped transverse edge **240** moves laterally into sealable engagement with the elongated sloped transverse seal **270** so as to seal the sloped transverse space **268**. In the preferred embodiment, the elongated sloped transverse seal **270** is a shaped, resilient temperature resistive material that is slightly compressed by the sloped transverse edge **240** when the outer hoistway doors **226***a* and **226***b* are moved to the closed position.

In an alternate embodiment illustrated in FIG. **33***b*, an elongated sloped transverse seal **271** is mounted to the outer hoistway door **226***a* and **226***b* along the entire sloped transverse edge **240** oriented toward the engagement leg **266** into the sloped transverse space **268**. The elongated sloped transverse seal **271** extends away from the sloped transverse edge **240** such that when the hoistway doors are in the closed position, shown in solid lines, the elongated sloped transverse seal **271** is pressed into sealable engagement with the engagement leg **266** so as to form a seal within the sloped transverse edge space **268** and block any gas or smoke from flowing therethrough in the event of a fire or the like.

Accordingly, when the outer hoistway doors **226***a* and **226***b* are moved from the open position to the closed position, the hoistway doors move laterally to form seals around the entire hoistway entrance between the hoistway door assembly and the wall structure and between the meeting edges, bottom edges and interdoor edges of the hoistway doors. Thus, all of the spaces around and between the hoistway doors are effectively sealed off when the doors are in the closed position so as to limit the flow of gas or smoke in the event of a fire, thereby minimizing migration of smoke through a building during a fire or the like.

Although the embodiments described herein are described in terms of the seals around the hoistway door blocking the flow of smoke and gas in the event of a fire, the seals are also effective in blocking the flow of air or the like between the hoistway door and the wall structure during operation or maintenance of the hoistway.

From the foregoing, it will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without deviating from the spirit and scope of the invention. Accordingly, the invention is not limited except as by the appended claims.

I claim:

1. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the door is closed, comprising:

a wall structure having an opening therein defining a hoistway entrance;

a hoistway door for covering at least a portion of the hoistway entrance;

a seal structure supported between the hoistway door and the wall structure;

an elongated door support member positioned in a generally horizontal orientation, connected to the wall structure;

a door support connected to the hoistway door and movably connected to the elongated support member to support the door while permitting movement of the door in a lateral direction between an open position permitting access to the hoistway and a closed position wherein the door substantially covers the hoistway entrance with a space between the hoistway door and the wall structure; and

wherein the elongated support member has a top guide portion and a bottom guide portion adapted to guide the hoistway door in a second direction toward the seal structure, the second direction being different than the lateral direction when the hoistway door is moved to the closed position to cause the hoistway door to sealably engage the seal structure to seal the space between the door and the wall structure when the door is closed to limit smoke flow, the bottom guide portion being a downwardly sloped portion that is engaged by the door support and that directs the hoistway door downwardly when the hoistway door moves from the open position toward the closed position.

2. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the door is closed, comprising:

a wall structure having an opening therein defining a hoistway entrance having a headwall, a pair of lateral jambwalls, and a sill;

a moveable, hoistway door that removably covers at least a portion of the hoistway entrance, the hoistway door having a leading edge and a trailing edge;

a door support rail positioned in a generally horizontal orientation and connected to the wall structure, the door support rail having a roller support surface;

a plurality of spaced, door support trucks connected to the hoistway door, each truck having a support roller engaging the roller support surface of the support rail and supporting the hoistway door while permitting lateral movement of the hoistway door between an open position permitting access to the hoistway and a closed position wherein the door substantially covers the hoistway entrance with the door spaced from the sill to define a sill space, spaced from the headwall to define a transverse space and spaced from the jambwalls to define trailing edge and leading edge lateral spaces;

a leading edge sealing structure supported between the hoistway door and the wall structure, the leading edge sealing structure sealing the leading edge lateral space when the hoistway door is in the closed position and restricting the passage of smoke in the event of a fire;

a trailing edge sealing structure supported between the hoistway door and the wall structure, the trailing edge sealing structure sealing the trailing edge lateral space when the hoistway door is in the closed position and restricting the passage of smoke in the event of a fire;

a transverse sealing structure supported between the hoistway door and the wall structure, the transverse sealing structure sealing the transverse space when the hoistway door is closed; and

a sill sealing structure connected to the bottom of the door, the sill sealing structure sealing the sill space when the hoistway door is closed;

wherein the support rail has a top guide portion engaged by each support roller, and a bottom guide portion guiding the hoistway door in a second direction different than the lateral direction when the hoistway door is moved to the closed position and causing the sill sealing structure to engage the sill to seal the sill space and causing the transverse sealing structure to seal the transverse space when the door is in the closed position, the bottom guide portion being downwardly sloped portions engaged by the door support trucks, the downwardly sloped portions guiding the hoistway door downwardly when the hoistway door moves from the open position toward the closed position.

3. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the doors are closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance having a headwall;

a pair of opposing hoistway doors that movably cover the hoistway entrance;

an elongated door support member positioned in a generally horizontal orientation and connected to the wall structure;

spaced, door supports connected to each door, each support movably connected to the elongated support member, the door supports supporting an associated door while permitting lateral movement of the door between an open position permitting access to the hoistway and a closed position wherein the doors substantially cover the hoistway entrance with the doors each spaced from the headwall to define transverse spaces;

transverse seal structures supported between each door and the wall; and

wherein the door support member has a top guide portion engaged by the door supports, and a bottom guide portion guiding the hoistway door in a second direction toward the transverse seal structures, the second direction being different than the lateral direction when the hoistway door is moved to the closed position, the movement of the doors in the second direction sealing the transverse space with the transverse sealing structures when the doors are in the closed position, the bottom guide portion being downwardly sloped portions engaged by the door support trucks, the downwardly sloped portions directing the hoistway door vertically downward when the hoistway door moves from the open position toward the closed position.

4. The hoistway door seal structure of claim **3** wherein the hoistway entrance has a pair of lateral jambs, and the doors substantially cover the hoistway entrance with the doors each spaced from the jambwall to define lateral spaces, and further comprising lateral sealing structures supported between each door and the wall, the lateral sealing structures sealing the lateral spaces when the doors moved to the closed position, the guide portions of the door support member moving the doors into sealable engagement with the transverse sealing structures to seal the transverse spaces when the doors are moved to the closed position.

5. The hoistway door seal structure of claim **3** wherein the hoistway entrance has a sill, and the doors substantially cover the hoistway entrance with the doors each spaced from the sill to define sill spaces and spaced from each other to define a meeting edge space, and further comprising an elongated seal connected to the meeting edge of one of the doors sized to contact the meeting edge of the other door when the doors are in a closed position to seal the meeting edge space, and an elongated seal is connected to the bottom of each door, the guide portions of the door support member directing the doors so the elongated seal sealably engages the sill and seals the sill spaces when the doors are in the closed position.

6. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the doors are closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance having a headwall, a pair of lateral jambs and a sill;

a pair of opposing hoistway doors for movably covering the hoistway entrance;

a door support rail positioned in a generally horizontal orientation and connected to the wall structure, the door support rail having a roller support surface;

a plurality of spaced, door support trucks connected to each door, each truck having a support roller engaging the roller support surface of the support rail to support the associated door while permitting lateral movement of the door between an open position permitting access to the hoistway and a closed position wherein the doors substantially cover the hoistway entrance with the doors each spaced from the sill to define sill spaces, spaced from the headwall to define transverse spaces, spaced from the jambs to define lateral spaces and spaced from each other to define a meeting edge space;

an elongated lateral extension extending from the lateral portion of each door toward the wall;

lateral seals, each extending from the wall toward the associated door in an overlapping relationship to the lateral door extensions to contact the lateral door extensions to seal the associated lateral spaces when the doors are in the closed position;

an elongated seal connected to the meeting edge of one of the doors sized to contact the meeting edge of the other door when the doors are in the closed position to seal the meeting edge space;

elongated transverse extensions projecting from the top portion of each door toward the wall;

elongated transverse seals projecting from the wall in an overlapping relationship with respect to the associated transverse door extension; and

an elongated seal connected to the bottom of each door; and

wherein the support rail has a top guide portion engaged by each support roller, and a bottom guide portion guiding the hoistway doors in a second direction different than the lateral direction when the hoistway doors are moved to the closed position to cause the bottom door seals to engage the sill to seal the sill spaces and to cause the transverse seals to engage the transverse door extensions to seal the transverse spaces when the doors are closed.

7. The hoistway door seal structure of claim **6** wherein the guide portions are downwardly sloped portions and the second direction is vertically downward toward the sill, the downwardly sloped portions directing the doors downwardly toward the sill when the doors are moved toward the closed position to cause the bottom door seals to engage the sill to seal the sill spaces.

8. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the doors are closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance having a headwall, a pair of lateral jambs and a sill;

a pair of opposing hoistway doors movably adjacent to the hoistway entrance;

a door support rail positioned in a generally horizontal orientation and connected to the wall structure, the door support rail having a roller support surface;

a plurality of spaced, door support trucks connected to each door, each truck having a support roller engaging the surface of the support rail to support the associated door while permitting lateral movement of the door between an open position permitting access to the hoistway and a closed position wherein the doors substantially cover the hoistway entrance with the doors each spaced from the sill to define sill spaces, spaced from the headwall to define transverse spaces, spaced from the jambs to define lateral spaces and spaced from each other to define a meeting edge space;

elongated lateral extensions on either side of the hoistway entrance, each projecting toward an associated one of the doors;

lateral seals projecting from each of the doors toward the wall in an overlapping relationship with the lateral wall extensions to contact the lateral wall extensions to seal the associated lateral spaces when the doors are in the closed position;

an elongated seal connected to the meeting edge of one of the doors sized to contact the meeting edge of the other door when the doors are in the closed position to seal the meeting edge space;

elongated transverse extensions projecting from the top portion of each door toward the wall;

elongated transverse seals projecting from the wall in an overlapping relationship with respect to the associated transverse door extension;

an elongated bottom door seal connected to the bottom of each door; and

wherein the roller support surface of the support rail has guide portion engaged by each support roller and a bottom guide portion guiding the hoistway doors in a second direction different than the lateral direction when the hoistway doors are moved toward the closed position to cause the bottom door seals to engage the sill to seal the sill spaces and to cause the transverse seals to engage the transverse door extensions to seal the transverse spaces.

9. The hoistway door seal structure of claim **8** wherein the guide portions are downwardly sloped portions and the second direction is vertically downward toward the sill, the downwardly sloped portions direct the doors downwardly toward the sill when the doors are moved to the closed position.

10. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the doors are closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance having a head, a pair of lateral jambs and a sill;

a pair of opposing hoistway doors movably adjacent to the hoistway entrance;

a door support rail positioned in a generally horizontal orientation and connected to the wall structure, the door support rail having a roller support surface;

a plurality of spaced, door support trucks connected to each door, each truck having a support roller engaging the surface of the support rail to support the associated door while permitting lateral movement of the door between an open position permitting access to the hoistway and a closed position wherein the doors substantially cover the hoistway entrance with the doors each spaced from the sill to define sill spaces, spaced from the headwall to define transverse spaces, spaced from the jambwall to define lateral spaces and spaced from each other to define a meeting edge space;

an elongated lateral extension projecting from the lateral portion of each door towards the wall;

lateral seals, each projecting from the wall toward the associated door in an overlapping relationship to the lateral door extensions to contact the lateral door extensions to seal the associated lateral spaces when the doors are in the closed position;

an elongated seal connected to the meeting edge of one of the doors sized to contact the meeting edge of the other door when the doors are in the closed position to seal the meeting edge space;

an elongated transverse extension projecting from the wall above the hoistway entrance towards the doors;

elongated transverse seals projecting from each of the doors in an overlapping relationship with respect to the associated transverse wall extension; and

an elongated seal connected to the bottom of each door; and

wherein the support rail has a top guide portion engaged by each support roller, and a bottom guide portion guiding the hoistway doors in a second direction different than the lateral direction when the hoistway doors are moved toward the closed position to cause the bottom door seals to engage the sill to seal the sill spaces and to cause the transverse seals to engage the transverse wall extensions to seal the transverse spaces.

11. The hoistway door seal structure of claim **10** wherein the guide portions are downwardly sloped portions and the second direction is vertically downward toward the sill, the downwardly sloped portions directing the doors downwardly toward the sill when the doors are moved to the closed position.

12. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the doors are closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance having a head, a pair of lateral jambs and a sill;

a pair of opposing hoistway doors adjacent to the hoistway entrance,

a door support rail positioned in a generally horizontal orientation and connected to the wall structure, the door support rail having a roller support surface;

a plurality of spaced, door support trucks connected to each door, each truck having a support roller engaging the surface of the support rail to support the associated door while permitting lateral movement of the door between an open position permitting access to the hoistway and a closed position wherein the doors substantially cover the hoistway entrance with the doors each spaced from the sill to define sill spaces, spaced from the headwall to define transverse spaces, spaced from the jambwall to define lateral spaces and spaced from each other to define a meeting edge space;

elongated lateral wall extensions on either side of the hoistway entrance, each of the elongated lateral wall extensions projecting towards the associated door;

lateral seals projecting from each of the doors toward the wall in an overlapping relationship with the lateral wall extensions to contact the lateral wall extensions to seal the associated lateral spaces when the doors are closed;

an elongated seal connected to the meeting edge of one of the doors, the elongated seal contacting the meeting edge of the other door when the doors are in the closed position and sealing the meeting edge space;

an elongated transverse extension extending from the wall above the hoistway entrance towards the doors;

elongated transverse seals extending from each of the doors in an overlapping relationship with respect to the associated transverse wall extension; and

an elongated seal connected to the bottom of each door; and,

wherein the support rail has guide portion engaged by each support roller, and a bottom guide portion guiding the hoistway doors in a second direction different than the lateral direction when the hoistway doors are moved to the closed position to cause the bottom door seals to engage the sill to seal the sill spaces and to cause the transverse seals to engage the transverse wall extensions to seal the transverse spaces when the doors are closed.

13. A hoistway door seal structure for limiting the flow of air through a hoistway opening when the door is closed to restrict the passage of smoke in the event of a fire, comprising:

a wall structure having an opening therein defining a hoistway entrance;

a hoistway door for covering the hoistway entrance, the hoistway door having a sloped top edge portion that sloped downwardly at an angle;

an elongated door support member positioned in a generally horizontal orientation and connected to the wall structure, the elongated support member having a generally horizontal support surface and sloped bottom surface opposite the horizontal support surface, the sloped bottom surface sloping downwardly at approximately the angle of the door's sloped top edge portion;

a seal structure supported between the sloped bottom surface of the elongated door support and the sloped top edge portion of the hoistway door;

a door support connected to the hoistway door and movably connected to the support surface of the elongated support member to support the door while permitting movement of the door in a lateral direction between an open position permitting access to the hoistway and a closed position wherein the door substantially covers the hoistway entrance with a space between the hoistway door and the wall structure, the door support retaining the sloped top edge portion at approximately the same distance from the support surface when the hoist way door moves between the open and closed positions; and

wherein the sloped top edge of the hoistway door is immediately adjacent to the sloped bottom surface of the elongated support member and the sloped top edge sealably engages the seal structure when the hoistway door is moved to the closed position to seal the space between the door and the wall structure when the door is in the closed position, and the sloped top edge of the hoistway door is positioned below and away from the sloped bottom surface of the elongated support member with an unsealed space therebetween when the hoistway door is moved toward the open position to allow uninhibited movement of the hoistway door between the open and closed positions.

14. The hoistway door seal of claim **13** wherein said hoistway door includes first and second opposing door panels, said first door panel having a first sloped top edge portion the slopes downwardly at a first angle toward said second opposing door panel, said second door panel having a second sloped top edge portion that slopes downwardly at a second angle toward said first opposing door panel, and said sloped bottom surface of said door support having a opposing first and second sloped sections, said first sloped section being positioned above said first door panel and sloping downwardly toward said second door panel and said second sloped section being positioned above said second door panel and sloping downwardly toward said first door panel, said first sloped section of said door support engaging said first sloped edge portion of said first door panel and said second sloped section of said door support engaging said second sloped edge portion of said second door panel when said door is closed.

15. The hoistway door seal of claim **13** wherein said hoistway entrance has a headwall, a pair of lateral jambwalls, and a sill, said hoistway door has a leading edge and a trailing edge, and said seal structure includes a leading edge sealing structure supported between the hoistway door and the wall structure for sealing the leading edge lateral space when the hoistway door is in the closed position, a trailing edge sealing structure supported between the hoistway door and the wall structure for sealing the trailing edge lateral space when the hoistway door is in the closed position, a transverse sealing structure supported between the hoistway door and the wall structure for sealing the transverse space when the hoistway door is in the closed position, a sill sealing structure connected to the bottom of the door for sealing the sill space when the hoistway door is in the closed position, wherein said sloped bottom edge of the elongated support member engages the hoistway door and causes the sill structure to engage the sill to seal the sill space and causes the transverse sealing structure to seal the transverse space when the door is in the closed position.

16. A hoistway door seal structure for limiting the flow of air into or out of a hoistway, comprising:

a wall structure having an opening therein defining a hoistway entrance;

a hoistway door sized to cover at least a portion of the hoistway entrance when in a fully closed position and to allow access to the hoistway through the hoistway entrance when in an open position;

an elongated door support member positioned in a generally horizontal orientation and connected to the wall structure;

a door support device connected to the hoistway door and movably supported by the elongated door support member to support the hoistway door for substantially planar movement of the hoistway door in a lateral direction between the fully open position and the fully closed position, when in the fully closed position a space is provided between the hoistway door and the wall structure; and

a seal structure positioned in the space between the hoistway door and the wall structure when the hoistway door is in the fully closed position, the elongated door support member adapted to guide the hoistway door to move along a path of movement in a selected direction relative to the seal structure between a partially closed position and the fully closed position as the hoistway door is moved into and out of the fully closed position, the seal structure having a door-mounted portion with a seal engaging surface positioned at a selected oblique angle relative to the door support, a wall-mounted portion having an angled seal mating surface positioned substantially parallel to the seal engaging surface, and

a seal attached to one of the seal mating surface and the seal engaging surface and sealably engaging the other of the seal mating surface and the seal engaging surface to seal the space between the hoistway door and the wall structure when the hoistway door is moved into the fully closed position to limit smoke flow through the hoistway entrance, the seal being spaced apart from the other of the seal mating surface and the seal engaging surface and out of engagement therewith when the hoistway door is moved into the partially closed position.

17. The hoistway door seal structure of claim **16** wherein the seal is mounted to the seal engaging surface of the door-mounted portion.

18. The hoistway door seal structure of claim **16** wherein the hoistway door includes a pair of opposing hoistway door portions.

19. The hoistway door seal structure of claim **16** wherein the seal structure is a transverse seal structure attached to a top portion of the hoistway door and to a portion of the wall structure above the hoistway entrance.

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